LECTURE NOTES

ON SOME OF THE

BUSINESS FEATURES

OF

ENGINEERING PRACTICE

DEPARTMENT OF
ECONOMICS OF
ENGINEERING
STEVENS INSTITUTE
OF
TECHNOLOGY

SECOND EDITION
1912

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LECTURE NOTES

LECTURE NOTES

ON SOME OF THE

BUSINESS FEATURES OF ENGINEERING PRACTICE

By

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President, Stevens Institute of Technology

WITH LECTURES AND PAPERS
BY OTHER AUTHORS

Revised and Enlarged

Department of Economics of Engineering
Stevens Institute of Technology
Castle Point, Hoboken, N. J.

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PREFACE TO FIRST EDITION

In this department the students are first required to read the "Reprints of Lectures and Papers" which were gathered together for the purpose of cultivating in them a more sympathetic attitude of mind towards the specific instruction which is in part covered in these lecture notes.

In writing these notes and in putting them together I have made no attempt to avoid repetition, but my aim has been rather to consider the same proposition from several points of view in the hope that I might so better remove the difficulties that have developed in the work of the classroom.

Experience with three senior classes has convinced me that this repeating and paraphrasing is required to enable me to give inexperienced students a firm grasp of the essentials included in my course, unable as I am, by reason of insufficient time, to afford them the advantages of extended practice in examples.

The actual repetition is far greater than is here indicated, for, in my lectures as delivered, I give many additional examples from my own experiences, selected to meet the difficulties of the students as these difficulties become apparent.

I do not hestitate to include commonplaces. My hope is that especially where these have to do with the ethics of our noble profession the members of my classes will, through a cultivated receptivity, come to accept these commonplaces as active and controlling truths.

These pages are placed in the hands of the students so that they need not be obliged to rely solely upon my spoken words, but may have something to study outside of the classroom in preparation for examinations.

Notwithstanding the fact that I have not been able so far to cover by written notes all of the matter included in my course, I feel that the students should be able to prepare on all I present because much that is most difficult to comprehend is here given in permanent form and the remainder I give them full opportunity to discuss with me in class.

The notes on the Law of Contracts were prepared at my request by my friend and counsel, Howard E. White, Esq., of the New York Bar, to whom I wish now to repeat my grateful acknowledgments.

The commencement address to the Class of 1904, delivered by Walter C. Kerr, Esq., would have been included more appropriately in the "Reprints of Lectures and Papers," but as this was not feasible I have reprinted it here that Mr. Kerr's sound advice, so admirably presented, may be preserved for future classes.

I hope that I may be able to develop from these and supplementary notes a text-book on the business features of engineering practice, based upon my experiences in the fields of Engineering and Business as to the matter, and upon my experiences in the classroom as to the most efficient methods to be employed in presenting this matter to engineer-students already pressed for time in which to perform their assigned tasks.

ALEXANDER C. HUMPHREYS.

The Stevens Institute of Technology,
Hoboken, N. J.

PREFACE TO SECOND EDITION

In preparing the second edition of my Lecture Notes certain additions have been suggested by the experience of the classroom and by changes, almost revolutionary, which have taken place in the industrial field.

As explained in the introduction to the first edition, the lectures and papers contained in Reprints were collected originally for the purpose of cultivating in the students a sympathetic attitude of mind toward the more specific instruction to follow. Experience in the classroom has shown that these papers can also be usefully employed as suggestive material for experience talks. Therefore, with the added addresses, they have been included in this volume as Part I.

In Part II I have brought together my own lecture notes which appeared originally in the first edition of these Notes and its several supplements. Much of this material has been rearranged to bring it into better sequence; and portions have been rewritten wholly or in part.

Considerable new material has been added, particularly on the all-important subject of depreciation.

The necessity for a correct understanding of the many questions involved in the complex subject of depreciation has been growing in importance more and more each year since my Notes were put into print. Then the subject had received far too little attention and less real study. Therefore, I was concerned chiefly to impress upon our students the necessity for making systematic provision on the books of account for the estimated accruing liability due to depreciation. While I pointed out that estimates of accruing depreciation should be checked and corrected whenever opportunity was found to determine the *actual* accrued depreciation, the determination of actual depreciation was not discussed specifically.

To apprehend the difference between estimated accruing depreciation, to be included as one of the annual charges against income, and actual depreciation, as found in the appraisal of existing plants, has become, in the last few years, a matter of supreme

importance in connection with the appraisal of plants for rate-making cases.

Particularly this distinction is of vital importance at the present time because many theorists and "Experts," who have had little or no practical experience but yet have exercised, and are exercising, a strong influence upon public opinion and, still worse, upon members of Commissions and Courts, insist upon confusing estimated accruing depreciation and actual depreciation and therefore insist that an existing plant should be depreciated on the basis of estimated average life of plant and actual age irrespective of the facts as to physical decay, obsolescence and inadequacy determinable through competent inspection.

The theorists who fail to thus differentiate between the two classes of depreciation also fail to differentiate between actual depreciation which may occur most irregularly throughout the life of plant, and the scheme of accounting which aims to spread uniformly over the years benefited the total depreciation of the period.

Recognizing how increasingly important it is that our engineers should take the lead in the solution of these questions, I have treated separately these two classes of depreciation.

Also, I have considered more at length than in the first edition some of the many questions involved in the practice of compensating for depreciation by investing the depreciation fund in betterments and extensions.

In Part III I have gathered together a number of special lectures, some of which have been delivered to our senior classes and some of which have been written especially for this volume. All of these are intended for use with future classes, following the instruction based upon the contents of Part II.

Mr. Howard E. White's notes on The Law of Contracts and The Law of Agency have been used by him for a number of years in lecturing to our senior classes and were included in the first edition of these Notes.

Mr. William R. Baird has for a number of years lectured to our seniors on Patents and Patent Law, but these lectures were first reduced to permanent form for inclusion in this volume.

Mr. Edmund Dwight's lecture, Employers' Liability and Workmen's Compensation, was delivered for the first time to the Class of 1911.

Mr. H. L. Gantt's lecture, Task and Bonus in Management, was delivered a few years ago as a special lecture to our seniors and juniors, and is reprinted from the *Stevens Indicator* of April, 1908.

Mr. H. P. Gillette's lecture, Gathering Engineering Cost Data, was delivered in 1903, at Columbia University, and is reprinted by permission from the July, 1904, issue of the "School of Mines Quarterly."

Other lectures, written expressly for this volume, are as follows:

Accidents to Employees and Liability Therefor, by Mr. Louis L. Babcock.

Costs, by Mr. J. Newton Gunn.

An Analysis of Work, by Dean Herman Schneider.

I am also permitted to include three addresses on Banking by Mr. Frank A. Vanderlip.

I avail myself of this opportunity to renew the expression of my obligation to those who contributed to the Reprints and the first edition of these Notes and to extend my sincere thanks to those who have contributed additional matter for this edition.

In general, while in revising these Notes I have aimed to make them more complete and more convenient for use in the classroom, I have not attempted to produce a concisely worded textbook. My experience in the classroom has failed to persuade me that all repetition should be eliminated.

I wish to thank most sincerely Dr. F. L. Sevenoak for the assistance he has so ungrudgingly given me in carrying this book through the press.

ALEXANDER C. HUMPHREYS.

Stevens Institute of Technology,
Castle Point, Hoboken, N. J.
1912.

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PART I

REPRINTS OF SPECIAL LECTURES, PAPERS AND ADDRESSES

INTRODUCTION

Alex. C. Humphreys of the Class of '81 of Stevens Institute of Technology, and H. de B. Parsons of the Class of '84, previous to 1897 combined in suggesting that, as far as time would permit, instruction should be given, at least to the members of the Senior Class, on commercial conditions and methods affecting engineering enterprises.

The result of these suggestions was that a course of four lectures was delivered to the Senior Class in the spring of 1897. The first lecture was prepared by Mr. Humphreys and the second by Mr. Parsons. Mr. Humphreys was prevented by illness from delivering his lecture, so it was delivered by Mr. Parsons on the same day that he delivered his own. The following day Mr. George R. Turnbull, vice-president of the Guaranty Trust Company of New York, gave a lecture on "Accounts and Accounting"; and two days later Mr. William Sherrer, manager of the New York Clearing House, gave his lecture on "The Relation of Money and Banking to Engineering Work."

During the next college year it was not found practicable to provide regular instruction along the lines suggested, but a brief course in accountancy was offered to the Senior Class in the spring of 1899, as explained in the paper by Mr. Humphreys, entitled, "Should the Stevens Curriculum include Instruction in Bookkeeping and Accounting?"

When Mr. Humphreys assumed the presidency of Stevens Institute, he promptly determined to enlarge the scope of this instruction and, as a result, the Department of Business Engineering was established under his direct supervision; the title of the department being later changed to "Economics of Engineering."

In addition to the four lectures or talks above named, the pamphlet entitled "Reprints of Lectures and Papers" contained, as originally published, the following four articles:

"Should the Stevens Curriculum include Instruction in Bookkeeping and Accounting?" by Alex. C. Humphreys, reprinted from the Stevens Indicator.

"Business Training for the Engineer," by the same author, reprinted from Cassier's Magazine.

"Factory Depreciation," by Ewing Matheson, reprinted from Cassier's Magazine.

"The Commercial Side of Engineering," by Walter M. McFarland, reprinted from Cassier's Magazine.

There are now added to this group of lectures and papers the addresses delivered to the graduating classes of Stevens Institute of Technology from 1903-1911: one of these by Walter C. Kerr was included in the first edition of "Lecture Notes."

IS A KNOWLEDGE OF BUSINESS METHODS OF IMPORTANCE TO THE ENGINEER?

By

Alexander C. Humphreys

With many of us who are engineers and with some of us who are graduates of Stevens this question hardly admits of discussion. Our professional and business lives have demonstrated to us practically and completely that the engineer who aims to be more than a mere subordinate should be acquainted at least with the methods ordinarily pursued in business life and that even to the subordinate such a knowledge is of importance.

But on the other hand there are many who will tell you that the engineer is above the necessity for such an addition to his curriculum; that he can, if necessary, hire his bookkeeper and his business manager for a moderate compensation, and much to the same effect.

My experience goes to show that the men who thus argue are liable to wind up by being hired at a moderate salary by the business manager.

A number of us who are Alumni of Stevens have for some time felt that it might be of considerable importance to the students, yet to start out in life, if they could by some means be impressed with the importance of a knowledge of business methods.

Mr. H. de B. Parsons, Stevens '84, the late president of the Alumni Association, made this idea a prominent feature of his presidential address last year; and to him we are largely indebted for bringing the present plan to a trial.

We have all appreciated that the Stevens Course is a most severe one and that it should not be unadvisedly added to, but we have thought that something could be done by means of a short course of lectures, which, if appreciated by the students, would be really useful to them.

President Morton has from the time of the first suggestion encouraged the making of the trial, and I doubt not that his own experience as a successful man of affairs has argued with him in favor of the new departure.

It cannot be expected that through the medium of a few lectures you can become competent bankers, merchants or even accountants, but it may be expected that even these will be sufficient to impress upon some of you at least that a knowledge of business methods is of importance to the engineer and to teach you the underlying principles involved. If, with your co-operation, we can accomplish this much, we shall feel well satisfied.

My experience as an employer of technical men, most of them graduates of Stevens, has taught me that many, even of the more sensible ones, the ones best endowed with common sense, have at first failed to appreciate that there was anything in connection with business methods which demanded their respect. This has been the weakness with a number of otherwise strong men. It has been their inability or reluctance to learn in this direction which has a number of times necessarily prevented them from obtaining promotions which otherwise they had earned. I could, if I thought it desirable, give a number of cases which would drive home this part of my argument.

A friend of mine was recently talking to me on this subject. He is a capitalist and a large employer of labor of various grades. He spoke of Stevens graduates as being in his experience excellent men *after they had been out of college about three years;* that it took about that long for them to get over the feeling that they occupied a lofty plane as compared with the business man, and to appreciate that it was necessary they should learn some things from the business man if they wished to fill positions of responsibility.

Another, and an intimate friend, who is one of the best-balanced men that I know, a practical engineer, a remarkably strong man in business and financial affairs, a man who though self-educated is well educated, and who has a profound respect for a technical education, says that he is continually disappointed

that he cannot promote his technical men as rapidly as he desires and the reason is that they are lacking as business managers.

Another friend, a graduate of Rensselaer Polytechnic, and now occupying a position of great responsibility, having worked up from the practical side of his business, told me recently that there was no part of his course which, in looking back through his experiences, he felt had been so distinctly of benefit to him as some extra lectures on contracts and the law of contracts to which he had listened at the end of his course. I may not be prepared to go so far, but it may serve a purpose to show how strongly some successful practical engineers feel on this subject. This friend was most emphatic in the expression of the opinion that the technically educated men who had been the most successful under him were those who were able to see quickly that there was something beside the technical side of an education and that it was also necessary to be practical, systematic, business-like, familiar with the requirements of business life, and conscientious.

Probably the most important engineering society in the world is the British Institution of Civil Engineers. In its diploma or certificate of membership appears the following:

"A society established for the general advancement of mechanical science and more particularly for promoting the acquisition of that species of knowledge which constitutes the profession of a civil engineer, being the art of directing the great sources of power in nature for the use and convenience of man."

This statement shows clearly that ours is an eminently practical profession. We may be interested in science for science's sake, but that is not so in our capacity as engineers. In that capacity, we are, as a rule, simply called upon to apply the laws as already determined and laid down for us. We are to direct the great sources of power in nature for the use and convenience of man. A moment's thought shows how complete, for success, must be that harmony between theory and practice, so beautifully set out by Rankine in the preface to his Applied Mechanics; and this harmony of theory and practice must include harmony with the practice of the business world.

How are the great sources of power in nature to be directed, except by the employment of capital? And how is capital to be employed in connection with engineering work except in conformity with the regular methods employed in commercial life? Shall we alone refuse to accord respect to these methods and declare that commercial practice shall bend to our whims? Even then, some other methods must be substituted, and can we for a moment assume that the methods we would substitute would be generally preferable to those developed by specialists in that line through centuries of experience?

To me it seems absurd that any argument should be needed to enforce this simple point, but as I have said, experience has shown too fully the necessity for awakening technical men to their general weakness in this direction.

If I cannot by my arguments convince you that it is important to keep an open mind in this connection, then let me ask you to take it from me on faith. One or two have done this in the past, and they have been glad to come to me in later years and acknowledge that the faith was not misplaced.

I believe every man should have some knowledge of business methods, if only for his own protection; though I acknowledge, in the case of certain specialists, this necessity does not at once seem to be apparent, as, for instance, with ministers, chemists, physicians, dentists, etc. Even with the men of these professions the world would be benefited greatly if they were more business-like. It is for you to remember you are not a specialist in this same sense, for our profession is eminently practical and cannot be isolated from its commercial associations.

If I am right, and a knowledge of business methods tends to make your educational equipment more complete and more practical, you cannot, in this age of tremendous competition, afford to neglect this branch of knowledge. Bear in mind that the conditions surrounding capital and labor have changed greatly in the last twenty years, yes, in the last five years. Year by year it is getting harder to secure a fair return upon money invested. In the United States, many successes in the past have been secured only because the conditions permitted wasteful methods. These

successes under conditions more nearly normal might well have been dire failures. Think for a moment of the effect of building up in this country about 183,000 miles of railroad in about a half a century. That means, in a certain sense, a fictitious activity in many departments of industry, brought about by the spending of large sums of capital, chiefly foreign, brought out for investment. And now we have to pay the interest on this capital, and to help us in this, we are never again to have such a vast amount of work of development bringing in its train what is popularly known as "good times." This means that it will be harder to secure employment and harder to secure adequate compensation therefor. It also means that more and more must capital be husbanded. This all means, then, that in our work as engineers, the cents must be watched and accounted for. How is this to be done surely unless we are familiar with the methods employed in the financial world, and especially familiar with correct methods of accounting?

The engineer of to-day must be able to obtain not only good results in construction and in operation, but he must be able to record those results so that they can be completely analyzed and compared. It is to be noted that the man who does so record and analyze his results is seldom an extravagant constructor or operator.

Making some such argument as this to a friend of mine, a Stevens graduate and a successful man, he replied to the effect that there was no necessity for his bothering his head about such matters, as he could hire a bookkeeper for ten dollars a week to do such work for him. The kind of bookkeeping you can secure at ten dollars a week is not the kind I am talking about. I do not urge you to acquire facility in posting a ledger and in footing up long and wide columns of figures, but I am urging you to acquire an understanding of the underlying principles of accounting.

You do not go to Stevens Institute to become a mechanic, and still the course includes shop work. You aim by the combination of practical and theoretical training to become competent to direct mechanics intelligently. By such powers of direc-

tion you expect to be more valuable to your employer than the mechanic, even though the mechanic can earn at the bench better wages than you can.

This all applies to the case of the bookkeeper.

Because you may fail to compete with the mechanic in facility of execution is no reason why the shop course of Stevens should be abandoned, and because you cannot spare the time and effort to acquire great facility in the keeping of books, does not argue that you should not acquire a knowledge of the principles involved.

I have always felt that the responsibility of the engineer in this respect is greatly increased by reason of his mathematical training. With this training he should have no difficulty in easily mastering the principles of double entry bookkeeping, for the system is logical and consistent. A man who has gone through the higher mathematics should be ashamed to confess that there are any terrors for him in double entry bookkeeping. The trouble is, of course, that at the beginning the engineer often fails to appreciate the value of this knowledge, and then later he is fully employed or lazy, and not knowing how to go to work, he pushes the matter to one side.

Let us suppose for an instant that you are called upon to examine into the value of a manufacturing property. Say that in connection with the examination there are presented to you a ledger trial balance, a profit and loss statement and a statement of assets and liabilities. It goes without saying that you should be able to understand these statements. Can you be sure of doing so without a knowledge of accounting by the double entry system? I speak of this system especially because it is the one almost universally employed in important business undertakings and it is the only system which can be employed safely by reason of the fact that if an error creeps in, probably no balance can be obtained and so the error is detected, which is not the case with the single entry system.

Returning to the question of the examination, you may reply that you can employ an accountant to make this part of the examination. Very true, you may do so in any case, but it would

still be necessary that you should understand the principles involved in the accounting, or it would be necessary that your accountant should understand much of the technical and practical part of the business, for without such a knowledge he could not be sure that the accounts were properly classified, and unless they were so the statements furnished would be valueless. I have repeatedly had experience of this kind. I have many times found the books of a concern so kept by the bookkeeper, the practical head of the concern being either ignorant or indifferent, that the profits were more or less erroneously stated, and this generally because items had been carried into construction accounts which should have been carried into operating accounts.

I could cite a number of most striking cases of this kind; in some of them it would have been difficult, to say the least, for an accountant to have discovered the errors unless he was specially trained in the particular business under examination. I have been engaged in some such cases where it has taken days, weeks, yes, even months, to get the accounts so straightened out that a completely accurate statement of results could be obtained.

Now it is to prevent just such a state of affairs as this and to enable you to detect it when it exists, that you should understand accounting.

Do not fail to recognize at once the importance of classifying carefully all receipts and expenditures.

It is the balancing of the operating accounts which at the end of the year determines whether you have made a profit or a loss by the year's operations.

If, now, you have improperly charged certain expenditures to construction or investment accounts, you have falsely increased the statement of your profits. If you draw this fictitious profit, you are really drawing upon your capital; if this is continued, it is not hard to say what must be the end. It is then of the utmost importance that the accounts should be competently and honestly classified.

This sounds simple enough. Let me assure you that in some cases it is extremely difficult to secure the desired result.

Let me give you a leaf from my own experience. I had under

my charge about forty gas works, and it was of course most desirable that the results should be compared carefully in the interest of economy; we finally secured a very complete system of united management. The same general business methods were employed at all the stations, the same system of classification was employed, and this was carefully displayed for the instruction of all by means of detailed charts and instructions. The vouchers were carefully checked up, month by month, at the home office. Systematic audits were periodically made by a trained corps of auditors. The superintendents and managers met me once a year to discuss results and the records of the same. And still, notwithstanding all this, we found that if the comparisons were to be conclusive they often had to be made while carefully bearing in mind all modifying conditions. Think, then, how difficult it may be to make comparisons between results obtained by concerns not working under a united and uniform system of management. Especially is it hard at times to distinguish fairly between charges to repairs and to extensions or improvements. Often construction is designed to replace plant which has been worn out in service. Here, then, care has to be exercised that the operating accounts are charged with their full share of the renewal and that the betterment or investment account is not called upon to bear more than its share of the load, thus impairing capital.

Those familiar with business methods will tell you that in this lies the pitfall which has ruined many a good business. In this direction may we look for the fault which in the past led to the reorganization of so many American railroads; over-capitalization in the first place, and later, repairs and renewals charged to construction accounts.

Some will say that it needs no special business methods or knowledge of accounting to know all I have now said; it only requires common sense. Very true, if the common sense is sufficiently developed. It will do no harm to point out, in any case, that your common sense has to be exercised in this direction, and then if you think that your common sense is not sufficiently developed, you may be correspondingly the more on the alert.

As a rule, as I have before indicated, my experience goes to show that technical graduates find their common sense lying so dormant in this direction that they refuse to believe there is anything here which demands their attention or their respect.

The proper charging up of the ordinary cash repairs and simple renewals, offers no difficulty. The cash as paid out will be charged to its proper repair account and it will be found at the end of the year in its proper place in the statement of profit and loss. But there are more complicated items. I have already referred to one, where the repair item is combined with one of improvement. You cannot be too careful in avoiding trouble here.

But there are repairs, or rather renewals, which have to be made at longer intervals, and the cost of which cannot fairly be placed upon one year's business. Means should be taken to arrive at as accurate an estimate as is possible of the life of this part of the plant, and year by year a sufficient sum should be written up to a deferred repair or renewal account, so that when this part of the plant does have to be renewed, the funds will be ready for the expenditures and they will not have been paid out in dividends, owing to misleading statements of profit and loss.

This points to the necessity for providing in your scheme of operation and accounting for the renewal of the entire plant at the assumed expiration of the terms of life of its several members.

But, you may say, surely an engineer may be able to design a good engine, or bridge, or roof, without a knowledge of all these matters. Possibly so in a subordinate capacity. But if this engine, or bridge, or roof is to be sold in competition, as it must be sooner or later, then the designer must also keep in mind that a minimum of cost must be combined with a maximum of efficiency. This means that every part of the work must be followed through the shop from tool to tool, and the whole carefully classified for future analysis and comparison.

And this brings us to another most important branch of our subject:

Shop accounts and their proper classification.

Before we can fix a price on an article to be sold, we should

know its cost. But this is hard to determine unless our shop accounts are kept accurately. I venture the assertion that in many of our large establishments only general results are known, and that for want of accurate, itemized costs some of the articles sold are sold at a loss and some of them are sold at a price correspondingly too high. This is not good business and must finally place those practicing it at a disadvantage with more competent competitors.

The shop cost must include not only cost of material and labor, but cost of tools and general wear and tear. And beyond shop cost, by means of a percentage charge or otherwise, each manufactured piece must bear its *pro rata* share of general expense and management, including that of the sales department.

This is a subject which should appeal to you at once, and therefore I may omit further reference to it, except to say that we had expected to provide for one lecture on this subject of shop accounting. We had hoped that either Mr. Frederick W. Taylor, of Stevens, '83, or Mr. H. R. Towne would have taken up the subject, but unfortunately, they were both unable to undertake the work this year. At the time of writing these notes, I am not yet informed whether other provision can be made. If not for this year, we shall hope to see the plan carried through next year.

We have been fortunate in arranging for a lecture by Mr. G. R. Turnbull, vice-president of the Guaranty Trust Company of New York, who will lecture to you upon the subject of double entry bookkeeping, accounting and office methods. We are fortunate in securing the services of a man so eminent in his vocation. Let me urge you to absorb fully what Mr. Turnbull will say. Part of it, I imagine, will be so concise, yet so full of meaning, that you may fail to take it in. Let me assure you that you are fortunate in getting your first lessons on this important subject from such a source. I wish that I had been so fortunate. My first experiences were through the medium of unaided common sense, and the experiences were unnecessarily severe.

Following Mr. Turnbull, Mr. William Sherrer, manager of the New York Clearing House, will give you a lecture on Bank-

ing and Business Methods. Here again we are to be congratulated that the manager of this great financial institution has consented so generously to aid us in this important work. I only hope that we may afterwards be able to tell these gentlemen that their unselfish efforts in our behalf have been appreciated.

In conclusion, let me repeat, that in my opinion an engineer, to be truly successful, must be more than a narrow specialist. He must have the special training, but he must have also the broader and more general training which comes from contact with the world and with things commercial.

Especially remember that the engineer is a man of practice. It is for him to apply knowledge. In his profession it is better that he should have a limited, if thorough, special training and a large capacity for the application of that training, combined with breadth outside of this special line, than that he should have a great store of knowledge without the ability to apply it practically. Do not imagine that I am depreciating profound and wide engineering knowledge. Lucky the man who combines such store of knowledge with the ability to use it for the benefit of the world and of himself.

But if I cannot have that combination, I prefer the limited amount of knowledge combined with the ability to apply it efficiently. Such a man can do thorough, conscientious, good work, and if he carries on his work in conformity with correct business methods, he can, while doing some good for the world in general, do some good also for himself in particular.

EXPERIENCE TEACHING

By

Harry de B. Parsons

In order that you may fully appreciate these lectures on "Business Methods," it is necessary that you should have a clear conception of their object. It is intended that they shall open up before your minds a vista into the future walks of your professional careers, and for those among you who are quick to perceive, they will no doubt help to smooth over many difficulties to be encountered on the practical side of life.

While not making you experts in any branch, they will bring to your attention such business subjects as are common to us all; and will widen out your spheres of thought, so that you may be the better fitted to enter, a few months hence, into the real competition of the world.

Among the many requisites that are essential to the man of business may be mentioned the following:

Always give great credit to the talent of others, and never underestimate their ability. It is thus well to believe that your competitor is always stronger than yourself, and that in order to achieve success you must do your best.

Be brief, clear and concise in your conversations and writings.

Be decided and have an opinion of your own. Do not qualify your views with such expressions as "if," "I guess," "I fancy," as they weaken your standing in the minds of your hearers.

When discussing professional topics with others, remember that as a rule you are better posted than they about your side of the subject, and that a clear and unequivocal expression of facts on your part will carry great conviction.

Should you make an error, never hesitate to acknowledge it, as a manly admission never hurt a man so much as his efforts to cover over the mistake.

Train yourself to take broad views of all subjects, and do not allow your ideas to be cramped by details. Study schemes,

whether projected or finished, in their entirety, remembering that when perfected the details can be worked out afterward.

The engineer of to-day must design his work not alone for its practicability, but also for its adaptability. The plan must be well adapted to suit surrounding and possible future conditions. This results in the fact that the most potent arguments for or against a project are those which arise from the business rather than from the professional standpoint. Some years ago when the British Government decided to supply its army, about to advance into the Soudan for the relief of General Gordon at Khartoum, with water pumped from the coast, it was decided to award the contract for the pumps to an American manufacturer. In reply to the criticisms put forward by the home makers, the government engineers replied that their decision was based on the fact that the concern in question was the only one which had actually built pumps for a similar service, and that they had no time for experiment or trial of other forms. This decision was based on purely business grounds, while the professional part of the problem did not enter at all.

The province of the engineer has become so amplified as to include professional advice in many business councils. The capitalist is not satisfied with the answer to "What will it cost?" but demands a reply to "Will it pay?" While the first query is of purely professional character, the second is founded entirely on business considerations. In short, the work must be so planned that the interest on the cost added to maintenance and operating charges must be less than the receipts. As an illustration I have in mind a certain scheme which was excellent, *per se,* since there was an established trade. It became necessary to build a new structure to replace the old, and the professional men retained so ignored the business considerations of the problem as to reduce the company to a state of bankruptcy. Their purely professional work was no doubt well done, but so needlessly costly as to produce dire results through the enormous interest charges involved. A miscarriage in business judgment is just as damaging to one's reputation as a professional failure.

Remember that "money makes money" and that great consoli-

dations appear to be the order of the day. In order to insure success, these combinations must be thoroughly "business-like" in all details of management, which applies, in no minor degree, to the allied work of the engineer.

Since the capitalist stands as owner, he must be always the master, while the professional man remains as servant, because he acts in the capacity of assistant to carry out the former's views. Furthermore, the greater the position of responsibility, the more does the engineer's time become engrossed with business matters and the wider does he depart from his purely professional work.

In all operations, the legal questions that are involved, directly or indirectly, must be treated as omnipotent. Under such conditions money is well spent in advance to secure the best opinions. As nothing in this world is too good to use, do not hesitate to secure the best advice, and never rest content with that which is commonly called "good enough."

The subject of "Laws of Contract" is but one branch of legal work, and yet is sufficiently extended as to occupy the life study of some of our most noted lawyers. Do not then imagine that you can become contract lawyers and at the same time keep pace with the developments of your own profession. Each different state has its own laws, and this fact complicates the problem to such an extent as to warrant your retaining a good lawyer to assist in drawing up the contract clauses to be attached to your specifications. Bear in mind that the courts interpret what you may write. You can call for any conditions that you please, but if the ruling of the courts be adverse, the actual meaning may be just contrary to your intentions. One of the most absurd as well as dangerous positions in which a man can place himself is that of a "know all." No man can expect to be well posted on everything. It is an absolute impossibility to know it all.

All such engineering work as the study of general plans for large enterprises, valuations, examinations and reports, places the engineer in the closest contact with the capitalist. It is, therefore, highly essential to have a knowledge of the principles involved in business methods, including bookkeeping and accounting. It is often the case that the engineer can make a success out of failure

through his professional experience coupled with his business knowledge.

Above all things be true to yourself and be honest in your convictions. Do not assume responsibilty which does not belong to you, but be ready to answer for your subordinates. A man who is not true to himself, cannot and must not expect the respect of the world.

ACCOUNTS AND ACCOUNTING

By

George R. Turnbull

In my endeavor to supplement the able address on "Is a Knowledge of Business Methods of Importance to the Engineer?" given by your Mr. Humphreys, I will, as far as the brief limits of time permit, present to your attention the importance of accounts and accounting as one of the leading features of a business education.

In primitive times, when "swopping" or bartering was the only method of trading, the necessity for accounts was not felt, and bookkeepers were not in demand. But when trading became further advanced, when barter through the medium of traders took the place of barter direct, when things were represented by money prices and values, it then became necessary to keep some kind of a record of the transactions and the amounts involved. And here I would suggest a thought for your consideration, and it is—that barter is as absolute to-day through the medium of a merchant and by the use of money as when commodities were passed from hand to hand; and following out this idea practically and logically, you will arrive at the conclusion that money does not make prices, for the reason that no one will continue to produce crops or wares which do not finally give a satisfactory return in the things he is accustomed to receive in exchange, or, to put it in the language of the day, we cease to follow any business or vocation that "does not pay."

When our transactions are few and far between, we may trust to memory. I have known men who carried their business in their heads, but it is a great waste of effort and brain to place such a tax on memory, and memory, however good, cannot be relied upon to recall all the facts, dates and figures involved in numerous transactions, hence recourse to a record of some kind becomes a necessity.

Any one can put down a statement of the bare facts involved in a transaction that will serve to refresh the memory in regard to

it, but when the transactions are of any importance, it becomes absolutely necessary to go further, and the record must show not only our original possessions and the dispositions made of them, but our exact relations at any given time to those with whom we trade and have dealings, especially where credit is involved. This suggests the need of some systematic method for arriving at these results, and what is known as single entry bookkeeping is the first outcome. The first step in this system is to enter simple statements such as the following:

That we have bought certain things from a certain person at a certain price, to be paid for at a certain time; or

That we have sold and delivered certain of our goods or property for a certain price, payable at a certain time; or

That we have received cash payment for goods delivered; or

That we have paid a certain party for goods received; or

That we have received the written promise to pay of a debtor in settlement of an amount due us (which promises are in bookkeeping known as bills or notes receivable); or

That we have delivered our own promise to pay for value received (known as bills payable); or

In the event of an exchange, as often happens in real estate transactions, a record of the exchange made, with a description of the properties; or

That we have paid not for goods but for services, for rents, for interest, or expenses of any kind; or

That we have received payment for services, rents, etc.

These are all natural entries suggested by the facts in the case, and these entries (known as original entries) are the groundwork of all systems of bookkeeping and are of the utmost importance, because they are the only entries recognized as evidence in proceedings at law. And, in this connection, I want to emphasize the importance of making original entries so complete that ever after the transaction may be as readily understood from the entry as when it was actually made. Nine tenths of the trouble with bookkeepers arises from the incomplete and careless manner in which first or original entries are made. Brevity may be the soul of wit, but it is frequently the confusion of accounts.

These entries, with the exception of matters pertaining to cash, are usually entered in what is called the day-book. Cash items are usually entered in a book known as the cash-book, which is simply a subdivision of the day-book used because of the more convenient determination of funds on hand.

In both single and double entry bookkeeping, the ledger accounts are headed with the names of the parties with whom transactions are had, and also such impersonal accounts as merchandise, cash, bills receivable, bills payable, expense and subdivisions thereof, and others according to the character of the business, and from the day-book and cash-book are transcribed into the ledger the amounts involved in the various transactions. This is called "posting."

Now, it must be very apparent to you that the omission of an entry, or the failure to transcribe an entry into the ledger, opens the door to loss and error. This cannot happen without discovery in cash transactions, because the cash is usually footed and proved, and the balance, if it does not prove, evidences the failure to make an entry, an error in making one, or a mistake in handling the money. This method (single entry) is the one that commonly obtains among retailers and petty tradesmen, and though it is called "single entry," I am sorry to say that an examination of tradesmen's bills sometimes leads to a belief that they possess some latent knowledge of double entry.

Because of the grave probability of error and great possibility of fraud, single entry bookkeeping, even in its best form, is unsatisfactory, and is not used, except in rare instances, outside of retail business. The only system worthy of consideration is that known as double entry bookkeeping, sometimes called the "Italian Method," because of its Italian origin. Double entry bookkeeping may be defined as the most accurate method or system of recording business transactions—its very nature requires the record of all, not part, of our transactions.

I want to say, in preface to my description of double entry bookkeeping, that we have in every trade, barter or transaction, by whatever name you designate your dealings, an exchange. This exchange involves a person, firm or corporation with whom the

exchange is made. Keep this thought clearly in your minds, for from this springs one of the fundamental rules of bookkeeping, but before giving it I want to state the first rule, which is, that for every debit there must be a like or equal credit—equal, that is, you may have any number of debits to persons, say for goods, the aggregate appearing in one amount at credit of merchandise account; or any number of credits and only one debit, the debit being the sum of the credits. This leads me also to call your attention to the word "balance," so frequently used in connection with accounts. You are aware that the word balance is synonymous with scales, and the old-fashioned scale with its two pans furnishes a very simple illustration of this prime rule of double entry bookkeeping. Suppose a pair of scales before us—if we put as much in the one pan as in the other, the scales would stand even, or balance. This is equally true in bookkeeping by double entry. For, if we debit one account with $1,000, and credit another with $1,000, the amount at debit and the amount at credit, being equal, balance, and the statement of that fact would be what is known as a "Trial Balance Sheet," which is a statement of all the balances on the ledger, and on which, if correct, the total of the debit balances agrees with the total of the credit balances. This is the rule which gives rise to the name "double entry."

A very important feature in connection with double entry bookkeeping is that property, goods and possessions are treated as debtors—the accounts are known as impersonal accounts, taking their titles from their character, such as cash account, merchandise account, bills receivable, real estate account, bond account, or, in a manufacturing business, in addition, such as machinery account, tool account, fixture account, etc.

We will illustrate the matter by supposing that you are going to start in business. People commence business with money. Sometimes, however, only with credit, a very valuable possession, because it is given, as a rule, only to those who possess ability, industry and integrity—three winners in the race for success.

To open your books, you would start your cash account and on the left hand side of the page enter, "Cash, Dr. to —— (yourself)" for the amount of money in your possession. The

left hand page in cash and the left hand columns of ledger and journal are always the debit, and the right hand side the credit. Now here we have the account of the thing (cash) debited and the account of the person (yourself) credited. This illustrates, also, the only other rule involved in double entry bookkeeping, and that is when you part with a thing—merchandise, cash, real estate, or anything of value which is represented in your business, you credit the account of that thing and debit the account of the person to whom you give it. On the contrary, if you receive anything, you debit the account of the thing received and credit the party from whom you receive it. In other words, your possessions owe you—as well as individuals. To recapitulate: We have two rules which govern all original entries in double entry bookkeeping:

1. For every debit there must be an equal credit.
2. Debit the account of the thing received and credit the account of the party from whom you receive it; or, transposed, credit the account of the thing given and debit the account of the party to whom you give it.

We now have in our minds the rules governing our entries and the importance of making our entries so clear and complete that they never require any explanation. Let us now consider the books themselves on which the entries are to be made. Originally, and down to quite recent years, a set of books consisted of a day-book, cash-book, journal and ledger. In the day-book were made all original entries of purchase, sales, exchanges, settlements—everything except cash matters. It was formerly the rule, which is still occasionally practiced, to re-enter in the journal in the technical form all entries from day-book and cash-book, as:

April 9.	Jones and Co., Dr., to Mdse.	
	For goods sold them on six months credit, as per Day Book, folio 11	$1,000 00
or	Mdse. to Smith & Co.	
	As per their invoice of April 9, for 10 cases of sheeting bo't on four months credit, per Day Book, folio 12	500 00

or Sundries Dr. to Cash,
(Comprising each of the parties to whom cash was paid, the purpose of payment, etc.).

From the journal the entries are posted into the ledger under their respective accounts. As in the cases cited, merchandise account would be credited under the date of

April 9. By Jones & Co., July 1..... $1,000 00

and Jones & Co. would be debited under the date of

April 9. To Mdse., July 1..... $1,000 00

The journal has two columns: one, the left, for debits, and the other, the right, for credits. These are footed and carried forward to the end of the month (usually) and the agreement of totals shows that the debits and credits are equal, and as to amount, correct.

With a view to the economy of labor, the journalizing of sales, purchases and cash is now dispensed with, and instead, the sales are entered in a sales-book, purchases in an invoice-book and postings are made direct from these and the cash-book into the ledger. Of course you will understand that in various lines of business similar books may be introduced adapted to the particular business in view—my purpose is simply to call your attention to the fact that the former method of journalizing all entries is not now followed, as a rule.

The ledger, when all the entries are posted, on one side ordinarily shows credits to ourselves for our capital (which the business owes us), credits to others for amounts the business owes them, credits to bills payable (obligations given in settlement of debts), and perhaps, credits to accounts showing gains. On the opposite side, debit accounts of parties owing us, debits to bills receivable (obligations of parties due us), debits to merchandise account, cash account, or other property accounts, and expense accounts, and others as the nature of the business may involve. I only mention some general features.

Debit accounts are usually assets.

Credit accounts are usually liabilities.

The exceptions are the accounts which are involved in the determination of gains or losses, such as expense account (which may have any number of subdivisions), interest account and

profit and loss account. These accounts when at the debit are not assets, for they represent nothing and nobody, and if there were no profits to offset them, would have to be charged to capital account—but the usual course is once or twice a year to close the books (these periods are called fiscal periods), when an inventory of goods and possessions is taken.

We will suppose that we are doing a simple merchandise business, buying and selling. We shall have *charged* all our *purchases* to merchandise account, and we shall have *credited* all our *sales* to merchandise account. We will assume that our *purchases* have amounted to $100,000, and our *sales* to $90,000, but we find upon taking an inventory that we have goods on hand worth $25,000. Now, if we add the $25,000 to the $90,000 at credit of merchandise account, we have $115,000 as against a cost of $100,000. It is evident to you, therefore, that we must have made $15,000 profit. But to arrive at that in bookkeeping fashion, we debit merchandise account with $15,000 profit, and credit profit and loss account, bringing down a balance to the new merchandise account of $25,000, being the $10,000 balance already at the debit plus the $15,000 profit charged, making $25,000 as the value of merchandise and the debit to merchandise account with which to commence the new fiscal period. Now we find that we have $15,000 to the credit of profit and loss, but we have various expense and other debit accounts affecting the results of the business, and we debit profit and loss and credit these various accounts with their respective amounts (we may have also credit balances to other accounts, such as interest—affecting the result, and these we credit to profit and loss), and assuming that as a net result of these various debits and credits to profit and loss we have a balance of $10,000, this then is the net gain for the year, and we transfer it to our individual account by debiting profit and loss and crediting our account.

This is an illustration of what takes place, with more or less modification as to the number, character and distribution of accounts, in every business whose records are kept by double entry bookkeeping, in the determination of profits and losses. In large concerns it is usual to adjust interest to the fiscal period by

calculating amount of interest they would receive and pay to that date if all accounts were to be closed, and if the balance is in their favor, charging new interest account and crediting old interest account, or the reverse if the balance is against them.

There is a remarkable feature in double entry bookkeeping—its universality. When you buy from A and credit him and debit your merchandise account, A on the other hands debits you and credits *his* merchandise account, and so the world over are the business records interwoven by the double entry system.

Another very remarkable thing is, that the principles involved in double entry bookkeeping have not undergone any change. Forms of books without number have been devised to facilitate and subdivide work, but the underlying, fundamental rules stand and this fact alone is sufficient to demonstrate its great and abiding value.

Now I have tried to set before you the basic principles of bookkeeping, and though I have been obliged to introduce some features of practice, I trust I have made myself clear. The next point I wish to talk about is bookkeepers. There is no occupation which admits of such variation in capacity as bookkeeping. Take a bookkeeper whose experience has been mercantile and put him in a factory, and, as a rule, he will be as much at home as if he had been transported to a foreign land. Ordinarily, however, a bookkeeper can go from one house to another in the same line and adapt himself to the changes in forms. Many, because of their clerical accuracy in making entries, in posting them and taking off trial balance sheets, pose as expert accountants, but very few have any real capacity for arranging and opening accounts adapted to the wants and character of a new business or venture. This is properly the work of an accountant, and involves not only the knowledge of accounts, but of affairs, and this knowledge of affairs is the feature distinguishing the accountant from the bookkeeper. The accountant is synthetic as well as analytic.

Your education is supposed to fit you for the practical or material side of business, the utilization of natural and mechanical forces in their various forms. To this you want to add the knowledge of the relation of your operations to financial results. This

knowledge, coupled with the ability to compare the results of your operations with the results of others, begets an ability to analyze and dissect affairs in general, and you become in time "men of affairs." To this end you should all look, you should all be men of affairs. I know of nothing that will add more to the value of your professional and technical acquirements than a knowledge of accounts sufficient to enable you to make a clear and intelligible showing of the operations and results of any venture or work in which you may be engaged.

In my experience of over thirty years, I have never found a clerk or bookkeeper who could not calculate interest in the manner usual in commercial life, but I have never found one who could explain the rule by which he arrived at the result. Thousands of men are engaged in keeping books (and in other pursuits, for that matter) who cannot state (for they do not know) the primary rules governing their work. They know "how" in a more or less limited way, not "why." If I had the power, I would place on the walls of every classroom in the land two precepts:

First. "Learn the WHY and you will always know HOW!"

Second. "Never expect something for nothing." For in life as in bookkeeping for every debit there must be a credit, and if these precepts are followed, there will be an ability to do and a willingness to give a fair equivalent in exchange for anything and everything desired.

And in conclusion, to you I would say—give your time, energy and ability to, and persevere faithfully in, your pursuits, and while you may differ in the measure of your success, you will all have success in a measure, notwithstanding differences in opportunities.

THE RELATION OF MONEY AND BANKING TO ENGINEERING WORK

By

William Sherrer

This paper is headed "The Relation of Money and Banking to Engineering Work." Before beginning it, I should say that I have treated the subjects very concisely. It has not been my good fortune to read papers at young men's colleges before, and possibly I have not enlarged upon the topics here quite as much as you are accustomed to hear.

The relation of money and banking to engineering work does not differ materially from the relation to any other business enterprise. It is the function of the banks to extend credit facilities to any and all undertakings which commend themselves to the judgment of their managers. It will, therefore, serve the purpose of this paper to lay before you a concise view of the history and practice of banking in general, and thus illustrate the important mechanism known as exchange in its broadest sense—involving not only the exchange of commodities *per se,* but the exchange of services and labor of all kinds as well. Money, which has been aptly termed the *tool* of exchange, becomes, by the assistance of banking, the great mechanical force by which almost all human activity is aided, encouraged and developed.

Money is utilized especially as a standard and a measure of values. In our modern life it has assumed various forms: metallic, in the shape of coin or bars; and paper representatives, including notes, drafts, checks, etc.

If you can imagine a state of civilization without money, you will at once conclude that during such a period, exchanges of products must have been attended with great inconvenience. For example, the shoemaker might readily obtain for the product of his labor a sufficient quantity of the butcher's commodities to last him several days; but since the butcher does not require shoes

every week, the cobbler would be compelled to find some one requiring shoes who would have something to exchange therefor, which the butcher desired; and possibly it would be necessary to examine into the needs of a number of persons before the second exchange of shoes for meat could be effected. The introduction of a medium which the maker of shoes could obtain from anyone desiring footwear, and which medium would be entirely acceptable to the seller of meats, manifestly saves the several producers much time and labor, enabling them to produce more or increase their leisure hours.

It is not necessary to pursue the evolution of money in greater detail, inasmuch as the natural results following the use of this medium will readily suggest themselves to your minds. Nor is it practicable in a short discourse to do more than refer to the obstructions which the debasement of money and the changes in the standard necessarily threw in the way of such a normal evolution as would have contributed marvelously to the more rapid development of civilization. We must, however, give some attention to what may be termed the second great human invention for the advancement of commercial intercourse, viz., the introduction of banking. I do not intend to convey the idea that this was an invention in the usual sense of the word: it was in fact a plant of exceedingly slow growth, retarded for centuries by untoward events, and not until the present era has the great value of this handmaiden to commerce been properly appreciated.

The first bankers were merely money changers, and the business was carried on largely by the gold and silversmiths, who were best able to judge the value of the thousand and one kinds of coins which the numerous great and petty rulers of the world put into circulation and which required continual adjustment. Gradually this class of individuals became the repositories of considerable sums of money, at first for safe keeping on account of having strong boxes, and eventually for profit, for they soon found it practicable to loan out at interest the funds deposited with them, since the owners did not require them for immediate use; and thus it became their business to induce persons of wealth to leave money with them, paying for the use of it. These goldsmiths

were, hence, the intermediaries between persons having a surplus of money and those having need of loans; reaping an advantage themselves from the difference between the rate of interest allowed and that which they demanded from borrowers.

Aside from the issuing of notes, to be considered further on, the function of banks remains practically the same to-day. It is their business to take charge of the money of one class of their clients, for or without consideration, and to provide the other class of clients with the sums needed for their enterprises; and the profit is still derived from the difference between the interest allowed upon the deposits and that received upon money loaned, whether it be to individuals upon their personal obligations, or to corporations or governments upon their bonds.

As we have seen, the first bankers were individuals; and to all intents and purposes the description fits the private bankers of to-day. When the practice of associating individual capital into corporations became prevalent, this was applied to banking business as well; and the great majority of banking offices in this country are now of the corporate kind. The advantages of this are apparent, affording, as it does, a means of combining a portion of the available means of a number of individuals in one enterprise, providing the power of supervision of the governing power, and definitely fixing the liability of each individual concerned, which in the case of a private banker is necessarily impracticable.

Several kinds of banking corporations exist in the United States at present: national banks, organized under federal laws and subject to visitation by officers of the federal government; state banks governed by laws of the several states; savings banks and trust (or loan) companies, also chartered by state authorities. Respecting the *banking* functions of the national and state institutions, no practical difference exists; the former, however, exercise the privilege of issuing notes; savings banks in the eastern states are not capitalized corporations, but are conducted by trustees, not for their own profit but for the benefit of the depositors; in many of the other states of the Union, savings banks are stock corporations organized for profit to those whose capital is

invested; trust companies are similar institutions, taking considerable sums upon deposit for periods more or less fixed.

The chief elements of difference may be briefly stated thus: savings banks receive small sums for relatively long terms, paying fairly high rates of interest; trust companies receive larger sums for shorter terms, at lower rates; banks receive both large and small sums repayable on demand, and do not necessarily pay interest. Manifestly, in order to carry out their engagements, banks must have at all times a considerable reserve of unemployed money for immediate payments, while the other institutions require but a small fund for this purpose.

Let us now examine the effect of banking upon commerce and industry. Every depositor receives from the institution some form of evidence that the sums are held for him. In banks these sums are subject to check, i.e., an order upon the bank to pay out the money. In actual practice, it should be remarked, the class of clients known as borrowers usually also become depositors, the banks placing the sum borrowed to their credit subject to check. Assuming now that A, B and C have deposited in bank for current business $200,000; and D, E and F have borrowed from the bank $100,000, which has been placed to their credit; the bank has thereby increased the amount subject to check to $300,000. Multiply this instance several thousand times, and you have an exhibit of what is taking place in New York daily. Assume now that individuals designated transact business with each other, the payments being made with checks, and it is readily seen that these paper orders take the place of the actual money and, aside from being more convenient, multiply the power of money many times. The sums are simply transferred from one account in the ledger of the bank to the other. Applying this to a considerable number of banks, it will be seen how much the evolution of the system has added to the forces available for the extension of human activity. Sixty-five institutions in New York City reported on Saturday last over $574,000,000 of deposits, and of actual cash less than $192,000,000; and this sum of money was $48,000,000 in excess of the proportion deemed satisfactory for the reserve purposes above mentioned.

To illustrate the banking process in the case of an engineering project, contemplated, for example, for the purpose of extending the operations of a railway: the officers of the bank would require that the managers of the railway company exhibit the financial condition of the property, its probable earning power and its obligations. The great utility of having all the details of the business of the enterprise clearly and accurately set forth in a balance sheet drawn up from the accounts of the company, is obvious. It is, in fact, impossible to exaggerate the importance of such an exhibit; for the question of the credit of a corporation is absolutely dependent upon it—its obligations cannot be placed without it; the machinery of credit cannot work properly without the accountant's intervention to certify that the borrower is solvent and carrying on a remunerative enterprise.

If the bank finds the exhibit satisfactory, the company's note is discounted, the credit is given and the sum involved is immediately subject to check; or, as is frequently the case with trust companies, the bonds of the railway corporation are taken and credit given either at once or upon their sale, which the trust company undertakes and in a measure guarantees.

It has been demonstrated that the power of money may be further multiplied with safety through the issue of bank notes—another form of paper representatives of money. The credit of an institution having been established, people in the vicinity are not loath to take, in lieu of the coin, a promise of the bank to pay the coin upon demand. The practice, which is of quite ancient date, has, until a comparatively recent time, been permitted to exist without restraint: private bankers, as well as incorporated institutions, very frequently issued large amounts of such promises to the confiding public beyond their powers to redeem them. The gross frauds thus perpetrated led to the legislative control of various kinds, under which the amounts of notes issuable is limited and proper provision for redemption made compulsory. Thus it is not uncommon to find a requirement that the note issues shall never exceed thrice the amount of actual cash in hand. This is regarded as a fairly safe reserve to provide for the notes that may be presented at any one time, and enables

the bank by the use of its credit to give the coin held for the purpose a threefold power in the commercial world. This does not, however, obtain in the United States, where banks which might otherwise avail themselves of the privilege under state laws, are prevented by a high tax upon issues of notes (10 per cent) imposed by the federal government, which has chartered banks of issue specially. But these latter can use the privilege only upon deposit of government bonds, which are held by the treasury as security to the note holder; the banks are not required to provide more than one dollar in twenty for the purpose of the redemption reserve, which is also held by the government.

This might perhaps be made a little clearer by this illustration: a national bank in this city, desiring to issue $100,000 in circulating notes, would be required to deposit $110,000 in government bonds with the Treasury Department in Washington. These bonds would be held by the treasurer of the United States in trust for the note holders. Should that bank fail, or should any of its officers run away with its money, the note holders would be amply protected—the United States Government keeping the deposited bonds in Washington. In addition to that, the bank must also deposit in Washington legal tender notes to the amount of $5,000 (i.e., $1 in every $20) for the purposes of the redemption reserve.

Our system of banking varies, therefore, from the usual form: ours are banks of deposit and discount, but hardly banks of issue in the proper sense; moreover the systems in other civilized countries almost invariably provide for one large institution, to which is given the issue power. Thus the Bank of England is the chief money issuing institution in Great Britain; it is, however, not authorized to increase the volume of the note issues as above described; for besides a small amount emitted upon government bonds, its notes may only be issued upon deposits of coin or bullion; thus the function of augmenting the power of money is confined to its deposit and discount department; and when the ratio between its cash and the amount subject to check falls, it discourages the increase of loans and consequently of deposits and check money, by raising the discount or loaning rate. This

frequently results in the importation of money from places where the rates are lower, affording relief to trade and yielding a profit to the owner of such money.

The Bank of France, on the other hand, issues notes very freely within a limit fixed by law at 4,000,000,000 francs; which sum is deemed sufficient for all the needs for many years to come. It is hence a much more useful institution than the one in London, combining, as it does, both of the chief functions for multiplying credit instruments; although by reason of the facility with which the note issuing power can be used, the check system has not attained a high state of development.

The American system lacks a great regulative institution such as exists abroad; the forces available are not therefore utilized as much as they might be. Nevertheless, 10,000 banks and bankers with approximately $600,000,000 of cash, supply a present banking power estimated at $6,700,000,000; showing that through these intermediaries the commercial and industrial enterprises have the power of money increased in this respect fully elevenfold. A much greater multiplication of forces is effected, however, by the system of clearing houses, which it is profitable to examine in greater detail.

The system of bank clearings now in vogue in all the principal cities in this country is an example of how a small amount of money may be made to settle a large amount of business. The work of the New York Clearing House is an example of the economy. The records of that institution for forty-three years show that but $4.65 per $100 is all the actual cash needed to transact the business of the New York banks.

Let me give you a brief description of its work—and here let me say that it would afford me great pleasure to have any or all of you young gentlemen call at the Clearing House and see the actual workings of that institution on any business day.

Prior to the establishment of the Clearing House, banks were obliged to present the checks and drafts received by them on deposit directly to the banks for payment—I refer to checks on banks in New York City. At that time there were over fifty banks in New York and some fifteen or twenty in the adjacent

cities of Brooklyn and Jersey City. The labor of visiting each of the banks daily and collecting in gold or currency the cash called for by the checks was very great, and the attendant risk of loss by robbery was considerable. It was a daily occurrence for one bank to have many thousands of dollars more against another bank than that bank had against it, and in turn have many thousands of dollars less against another bank. The constant adjustment of balances and the necessary transportation of money through the streets, the loss of time and the expense of the work, called for some improvement in the manner of transacting the business.

This was solved by the establishment of a central place, where each bank in the association could be represented by a clerk authorized to receive all checks chargeable at his bank and at the same time, with the help of an assistant, present to their representatives the checks his bank had against every other bank. Thus we had one, in place of fifty-six.

Let me describe the process of clearing; there are sixty-six banks who are now members, and seventy-seven non-members whose checks are cleared by member-banks. Each of these members is furnished with a desk; the desks are arranged in numerical order. The clerk of each bank takes his seat at his desk; the messenger stands in front of the desk with the checks of his bank arranged in separate bundles, one for each bank. At the signal each messenger advances and deposits with the clerk at each desk the bundle of checks for that bank. The tour of the room is made in ten minutes; when the messenger reaches his own desk, after making the tour, the packages of checks which have been received by the clerk of his bank are awaiting him. These he places in his now empty box and returns to his own bank. Thus, in less than one half hour two men have presented for payment all the checks which their bank held against one hundred and forty-two other banks—sixty-six members and seventy-seven non-members—and received all the checks presented against their bank by all the others.

Under the old plan it would have required the services of at least ten men for one entire day to do the work of presenting checks for payment received by one of our banks in one day's

business. This represents the saving of time now, as well as the use of a small percentage of money to the amount of checks brought to make the payments or settle resulting balances. Take the case of bank A as an illustration: We will suppose that bank A takes to the Clearing House checks drawn on other banks amounting to $1,250,000; for this amount that bank is credited on the books of the Clearing House; after the delivery of packages has been finished and the clerk of bank A has made a list of the amounts the other banks have presented against his bank and footed them up, he finds that amount to be $1,200,000; the result showing that bank A is credit $50,000. Why? Because the amount of the checks that that bank had against all other banks exceeds the amount all the other banks had against it to the amount of $50,000; so that the condition of each bank is soon shown for that day. Each of the sixty-six members will be debit or credit, as will be shown by the differences between the total amount of the checks brought and received by each. The balance sheet of the Clearing House of the day will show which is debit and which is credit. The total of the amount of checks brought to the Clearing House will, of course, be the total of the amount taken away; as of course the total of the debit balance will equal the total of the credits.

Now, as to the final settlement of these balances: the debit banks—or those who brought less than they received in checks—must pay the difference to the Clearing House in actual cash by a certain hour. After the debit banks have paid the amount owed by them, the credit banks are paid the amount due them caused by their having brought more to the Clearing House than they received in checks.

In this description of detail, I may have caused you to lose sight for the moment of the principle of economy in the use of money, as well as the saving of time, that makes the Clearing House system the useful and important aid that it is to the banking and business community.

The exchanges at the New York Clearing House average at the present time $90,000,000 per day. Were it not for this system, this, or most of this, large sum would have to change hands daily

with the attendant risk of loss. Now we find that less than five per cent of actual cash is needed to settle the balances resulting from the exchange.

You will observe that the bank is either debtor or creditor of the Clearing House and not to the individual banks (or *members,* as they are called) ; consequently they make one settlement instead of one hundred and forty-two.

Bank clearing houses have proved so useful to the banks and business men that there are now seventy-two of them in operation in the United States, all working upon the same plan as the Clearing House in New York City.

Thanking you for your attention, permit me to say in conclusion that in this lecture I have been able to give only the outline or a mere sketch of money and banking and their relation to business. As all business and professional work is largely dependent upon the bankers for success, let me urge upon you the necessity of acquiring a knowledge of the ordinary details, at least, of this important help to your future growth in your profession. It is an old and timeworn saying that "Knowledge is power." He who would have power must work and deserve it.

SHOULD THE STEVENS CURRICULUM INCLUDE INSTRUCTION IN BOOKKEEPING AND ACCOUNTING?

By

Alexander C. Humphreys

I have been asked to furnish the *Stevens Institute Indicator* copy of a lecture delivered by me to the Junior class at the end of the second term's course in accounting.

The so-called lecture was an informal talk in which I did not attempt to give instruction in bookkeeping, but only to impress upon the class, partly by a recital of my own experiences, the importance to the engineer of a knowledge of the fundamentals of accountancy.

I shall not attempt to reproduce this talk, but I shall endeavor to justify an affirmative answer to the question contained in the above title.

If this addition to our curriculum is to be permanent and is to be of practical value, the faculty and the students must first be convinced of the wisdom of the change.

If the students are to be fully benefited by this or any other feature of the course, they should not do the work under protest.

It is unquestionably a fact that students following a special, technical course such as ours, too often fail to appreciate that their studies should not be confined to the technical branches, but should be broadened out to include subjects of more general interest and value.

It is not uncommon to hear such students protesting against the study of the English language as waste of time; and frequently it is not until after graduation that they learn that it is necessary for them to have, not only the special knowledge and training admittedly required for their chosen calling, but also sufficient command of language to enable them to give expression, forcefully and without ambiguity, to propositions, statements, arguments, deductions and conclusions.

Many a Stevens graduate, otherwise well equipped, has been handicapped by this lack of ability to express definitely what he had in mind, and it is a source of congratulation to many Stevens alumni that steps have been taken recently to strengthen the curriculum in this particular.

It is to be hoped that the course may be still further broadened to include the language of the commercial and banking world, the world in which the successful engineer sooner or later finds it necessary to establish a standing.

While urging this addition to the curriculum, I am not unmindful of the fact that the students who are conscientiously living up to the requirements of the course, are already loaded almost to the breaking point. This means that for every addition to the course there should be a corresponding subtraction.

To cover in four years the practical and theoretical branches of our course in engineering makes necessary the careful discrimination between the practical and the simply academic consideration of science and mathematics.

While a strictly academic consideration of these branches is interesting and perhaps important, it must be discriminated against if we are to arrive at a maximum of practical efficiency.

It may be claimed confidently that the Stevens course is eminently practical, and the record of Stevens alumni is an unanswerable argument to this effect. But this does not imply that further improvement cannot be made which will render still more certain the graduation of men who can promptly and efficiently put into effect their Stevens training.

Certainly the curriculum must be of more practical value if it furnishes the student with such a fundamental knowledge of accountancy as will enable him to indicate accurate methods for recording costs of construction and operation, to determine the accuracy of such records when placed before him for examination, and to analyze intelligently statements of cost and profit and loss.

This subject I have discussed with a number of Stevens alumni, and I have sometimes been called upon to meet the statement that it is absurd to expect engineers to do bookkeeping work—they are not trained for it, and there is no reason why they should be

so trained; bookkeepers can be hired to do it for them. It might be replied that a man in going through Stevens does not expect to earn his living afterwards as a mechanic, and yet the course includes a very considerable amount of shop instruction, and it has been proved that such instruction is not only important, but necessary. If it is important to teach the engineer how to do mechanical work, and especially how to judge if such work has been properly done by others, is it not also important that engineers should be so equipped that they can indicate how the records of their work shall be kept so that they can determine accurately at the end of the year *what has been the commercial result of their operations?* And is it not important that they should also be able to judge as to the accuracy of claims made in regard to the profitableness of a certain process or undertaking?

An examination into the value of a process or of a plant necessarily involves the question of commercial results, and if a commercial record has already been established it would be folly to neglect that record. Such an examination is usually made in two parts; first, an engineering examination, and, second, an accounting examination. Unless these two examinations coördinate, the report may be worthless or worse than worthless.

Even in our own business we are called upon constantly to determine which is the most efficient or economical of two or more methods of doing the same thing. We may theorize on the subject, but the final, practical result must be learned through books of account.

Is it not, then, important that the engineer who becomes responsible for certain estimates of cost of construction, or of profit from operation, should be in a position to determine whether or not the books, as kept, accurately show the results obtained?

My experience goes to show that very grave errors are being made constantly in this direction through inability to bring into accord these two branches, and the deplorable condition of many a bankrupt concern is due to this failure to harmonize properly the engineering and accounting branches of the business. If an engineer is uninformed as to the ordinary steps in bookkeeping and accounting, he will be lost when he attempts to decide

promptly as to the correctness of certain fundamental entries. Probably he will be able finally to lay out the correct course if the question is forced upon his attention, but this, most likely, will be too late to prevent serious trouble.

As a result of considerable agitation on this subject, two years ago some lectures were given on business methods to the Senior class of Stevens.

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The next year instruction in this subject was not resumed, but in the spring of 1899 the Senior class was given a short course of lectures by a chartered accountant, but practically it was left optional with the students to attend the lectures or not; that is, no examination was insisted upon. This was found to work inefficiently. The students, fully burdened as they were with other work, naturally neglected a subject which was not made obligatory. It was therefore decided when the lectures were resumed for the benefit of the Junior class in the second term of this year to include an examination, and some effort was made to lighten the course in other directions. Those who are responsible for this addition to the curriculum appreciate that a knowledge of bookkeeping and accounting cannot be imparted in a series of ten lectures, but as the aim so far has been chiefly to awaken an interest in the minds of the students, and to instruct them only in the fundamental principles involved, it is felt that no more has been demanded of the students than could be exacted fairly.

In my efforts to impress upon the students the importance of this subject, and to get them to appreciate the final value to them of this instruction, I was able to give them many cases from my own experience, and I especially referred to four cases within the last year or so, where a knowledge of accounting was important in connection with questions of engineering practice. In all of these cases it was necessary either that the accountant should be thoroughly informed on the technical details of the business or else that the engineer should be capable of analyzing the statements of profit and loss.

The first case referred to was one of consolidation, and my report had to deal in part with the proportionate values of the constituent companies as determined mainly by net earnings.

My preliminary investigation led me to believe that the actual profits of one of the companies were far below the amount claimed and that the fictitious figures were obtained by charging to four construction or investment accounts expenditures which should have been debited to operating cost. As usual, the report was required within a limited time and the time limit did not permit of a complete audit and scrutiny of the classification of all vouchers. But familiarity with the technical and practical sides of the business enabled me to demonstrate that many items charged to the several construction accounts were not capable of being verified by corresponding extensions or improvements made to the plant during the year.

It was found necessary to credit these construction accounts and charge the proper expense and repairs accounts with about $200,000, thus reducing the net earnings for the year to that extent.

The profits, as ordinarily stated, had been further considerably swelled by the inclusion of items, such as premiums on bonds sold, which items were extraordinary in character and not therefore to be considered as part of the regular income when using the year's statement of profit and loss as a basis for estimate of future profits. These latter items, it is true, would have been readily detected and adjusted by any competent accountant, but the readjustment of construction and repairs accounts could not have been made without the engineer's technical knowledge, and it was only by the combination in one person of the knowledge of accounts and technical details that the work could have been completed with substantial accuracy within the time allowed.

Furthermore, so violently and persistently was the accuracy of the report assailed, that this combination of training was found to be a matter of great importance if not of actual necessity if my radical corrections of the profit and loss statements were not to be finally discredited.

The second case referred to was of quite an opposite character.

The company examined had for many years been operated in the interest of the bond holders. The result was that the net earnings were not fully shown, charges having been made regularly to repairs (operating expense) which should have been made against extensions of plant. Thus the mortgage had been "fattened" materially. Our examination was followed six months later by an examination by public accountants of high standing, assisted by an engineer, who, from lack of time and unfamiliarity with the particular branch of engineering involved, did not afford the accountants the requisite technical assistance.

The result was a report showing profits much below the facts. Upon the accuracy of this report being questioned the defense was made that a different result could have been obtained only by a complete audit including scrutiny of classification of all vouchers, and this last would probably not have been conclusive through inability to correct cases of involved classification after the controlling facts had grown cold.

Our widely different and more correct result was obtained in part by examining the vouchers, and in part by examining the inventory of plant at the first of the year and then, by detailed examination, determining the legitimate extensions and improvements made during the year.

In this case, as in all others, careful discrimination was made between repairs or renewals and extensions or improvements.

The third case was still different. It was an examination to determine why the cost of a certain large manufacturing plant had largely exceeded the original estimate. The classification and subdivisions assumed in the estimate had not been adhered to rigidly in the accounts as actually kept. An analysis was therefore impossible by a simple comparison between the estimate and the balances to the debit of the several construction accounts. A careful subdivision of each account was necessary and this had to be done by one familiar with the technical details of the plant.

Again it was necessary to determine whether or not the plant had been in all particulars constructed in accordance with the original specifications, or whether it had been in certain points increased or decreased as to capacity.

Many other technical features entered into the investigation. Some months were required to complete the work and the able accountants assisting were free to admit that a knowledge of accountancy alone would not have been sufficient for the accomplishment of the result sought.

The fourth case was quite different from all the preceding. It was an investigation to determine the value of a certain manufacturing process for which was claimed marvelous results. A profound impression had been made by the promoter upon some strong financial men, and especially by the use of the following two statements:

1. The process depended upon certain laws of nature not before known; therefore this process could not be valued by the "old-fashioned" science; and
2. The truth of the claims could be verified by the commercial results actually obtained in the case of a plant which had been in operation for one year.

Both of these are, as a rule, most convincing arguments to the average business man, and especially so when the two are combined.

After a careful investigation there was no difficulty in presenting to the trained engineer a demonstration of the absolute worthlessness of the process.

But the business man could not understand the technical points upon which this demonstration depended, and, furthermore, the adroit promoter had prejudiced the business man's mind in advance against arguments based upon acknowledged scientific truths.

It therefore became necessary to make a careful examination of the company's books to prove that the profits shown by the accounts and by the reports to the directors had not been obtained. The extraordinary operating results had been obtained while construction was still in progress, and thus no difficulty had been experienced in writing up operating cost charges to construction accounts.

The directors themselves had been deceived and thus had been led to furnish the promoter with endorsements of the process.

One of the results of this investigation was to throw the process out of this show plant and to install in its place the process which the promoter of the "fake" process was chiefly aiming to "strike."

It may be claimed that in all four of the cases here briefly described my work was not such as ordinarily comes to the engineer. But a little thought will show that in each and every case the troubles met and rectified could have been avoided by an honest and intelligent supervision of the accounts by the engineer in charge.

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In my talk with the Junior class this year I was encouraged to find that apparently a majority were interested and appreciated that the subject was one not to be lightly regarded. I was, therefore, all the more disappointed to find later that the class had entered a protest with the President against an examination, claiming that the instruction had not been sufficient to enable them to pass an examination. As the character of the examination had not yet been disclosed to them it was evident that the protest was premature. This was confirmed by the generally satisfactory result of the examination.

We had first to determine whether or not it was wise to introduce such instruction; and, second, whether or not we had acted wisely in the choice of methods. The result of the examination was largely to be depended upon to inform us on the last point. While suggesting where improvements and modifications could be introduced wisely, this result afforded encouragement in both particulars.

Students of a college or university should have in view the acquirement of a training which will best fit them for their life's work, and especially in the case of those attending such an institution as Stevens they should have in view the acquirement of a training and mental equipment which will best fit them to meet promptly the practical problems incidental to their life's work.

Some, though not many, go through college simply from the love of the knowledge to be acquired, but we can assume safely that with a large majority of student engineers their object is to make themselves of the greatest possible value to their employers, and, hence, to themselves. An engineer capable of intelligently considering questions of accountancy can command positions where a man only equipped to execute engineering work would be left unemployed; and, furthermore, the former's services will generally command a considerably larger compensation either in the form of salary from an employer or as profits from his own business.

This being the case, Stevens Institute, to keep up with its reputation for practicality, should give some instruction in a subject of such vital importance, if only sufficient to familiarize the students with the principles involved, and to show them why the subject is an important one to the engineer.

BUSINESS TRAINING FOR THE ENGINEER

By

Alexander C. Humphreys

Self-evident should be the truth of the proposition that the engineer ought to be a man of business, or at least, informed of, and prepared to conform to, business conditions and business methods. When this proposition is squarely laid before them it is self-evident to the majority of successful engineers and men of business. Business men, bankers and manufacturers not infrequently refuse their confidence to engineers and experts as a class, because, under trial, some individuals have demonstrated their incapacity to meet business conditions; from the standpoint of the man of business their reports, advice, conclusions have required interpretation and readjustment or amendment.

The man, so far somewhat exceptional, who is able to bring to the service of his clients or associates a sound technical training and the ability to meet business conditions, proves by his comparative success the material value of this dual capacity. For the sake of the profession and the country at large it is important that this broader capacity should no longer be exceptional.

To this end the professional educator and the engineer-student must better recognize the conditions to be met in practice. A general and definite demand on the part of the business world for engineers of broader capacity would ensure the necessary reform in the separate schools of engineering and the university departments of applied science. All that is possible should be done in the technical schools to harmonize theory and practice.

Great Britain recognizes this interdependence, and her foremost men are finding in the lack of sufficient technical training the explanation of Britain's loss of commercial supremacy. Professor John Perry, for example, concluded a notable address recently delivered before the engineering section of the British Association for the Advancement of Science in these words:

"When men can hardly take a step without seeing steam engines and electro-motors and telegraphs and telephones and steamships, with drain-

age and waterworks, with railways and electric tramways and motor cars, when every shop window is filled with the products of engineering enterprise, it is getting rather difficult for people to have any belief in evil spirits and witchcraft. All the heart-breaking preaching of enthusiasts in education would produce very little effect upon an old society like that of England if it were not for the engineer."

From a recent article by Sir Philip Magnus, on the present industrial importance of technical education, I give two short quotations:

"In the report of the special committee of the London County Council, to which I have already referred, it is, I think, conclusively shown that of late years we have lost other branches of trade than those above named, and that this loss is largely due to the superior educational equipment of our neighbors."

"The successful engineer must be, of necessity, a man of business."

After graduation the young engineer will be influenced by commercial conditions, and perhaps by his own natural bent, to become a specialist. To-day the field of engineering is so wide and the requirements are so exacting that no man can expect to excel unless he confines himself within certain rather narrow limits. But no matter to what part of the field he confines his efforts, he will find himself surely limited and bound, more or less, by commercial conditions.

From this it may be argued that the engineer should not aim to be also the commercial manager; as a specialist, he should confine himself to the engineering branch of his business. To this it may be replied that whatever special branch of industry is adopted, the engineer must understand and practice in harmony with the commercial conditions of that specialty. There may be a further specialization between the engineering and the commercial management, but the engineer should have at least a knowledge of the general fundamentals of business practice and also a knowledge of the special limitations attaching to the particular business pursued.

As in schools of engineering we cannot expect to instruct the students in all the specializations of engineering science and practice, so with instruction in business methods we cannot expect to give more than a broad training in fundamentals upon which the

student can safely and expeditiously build when the need for specialization is encountered.

If it be admitted that the engineer-student should receive some instruction in business methods before graduation, it then remains to be determined what can be added in this connection to a course already crowded almost to the limit. Perhaps the matter of first importance is accountancy. We cannot expect to train the students to be expert bookkeepers, nor is it necessary to do so; but we can expect to give them what is of more value and what many bookkeepers do not possess—sound knowledge of the principles of double entry bookkeeping. This knowledge engineers need, if for nothing else, to enable them to exercise a close, intelligent and independent supervision of manufacturing cost.

The students should be taught to discriminate carefully and conscientiously between the charges to capital or revenue, and they should be warned of the ease with which errors can be made in this connection and the disastrous consequences likely to follow their commission. They should also be shown the necessity for making adequate provision for depreciation of plant, the scheme to be based upon an exhaustive analysis of local conditions and not upon the blind acceptance of arbitrary rules formulated by accountants. They should be shown that books can be so kept, either through ignorance or design, as to hide the facts and to present a warrant for the payment of dividends unearned. They should be shown that all this, and much more, they will need if they are to be competent as managers or reliable as advisers in connection with the purchase of properties.

They should also be shown that often, when called in to pronounce on the value of some new apparatus or process where these have already been under commercial test, the technical investigation may be supplemented to advantage by a competent examination of the books of account; and that here the man who is only an engineer or only an accountant probably will be found incapable of conducting such an examination. In such a course should also be included enough instruction in the science of statistics to warn the student against the danger of drawing conclusions from insufficient or inconsistent data.

In connection with the work in this and other departments the effort should be made to bring the students to a keener appreciation of the value of a working command of English. They should be shown that it is not enough that they possess the knowledge, but they must have the ability to convey to others, and especially to their clients, in language concise and free from ambiguity, the results of their professional or administrative work.

Unquestionably there is a crying need for more efficient work in the teaching of English in the schools of technology, and perhaps this statement may fairly be extended to include some of the colleges and universities. Reform in this direction is most difficult of accomplishment. The work performed is too often of a perfunctory character, whereas it should be characterized by enthusiasm and originality. The time available is limited, and, therefore, the first care should be to give such a training in English as will be most efficient to meet the requirements of professional practice.

This leads naturally to another feature which should be included in the department of business methods—instruction in the law of contracts. We cannot expect to give engineer-students a working knowledge of the law of contracts, but we may very reasonably expect to impress them with the dangers to be encountered and the necessity of knowing when it is advisable to seek thoroughly competent legal advice. Some advice in this line can also, to advantage, be included in the lectures on engineering practice.

At Stevens Institute of Technology a course in business methods was started in 1897, though it was not until two years later that the work was put upon a firm basis. At first a number of engineers and bankers gave a series of lectures to the Senior class to point out by examples from their own professional and business experiences the necessity for the engineer to recognize that his work must be in accord with commercial practice. Two years later ten lectures on accountancy were delivered to the Junior class; but as this work was left optional, the students derived little benefit from it. For the last three years the course has included twenty lectures and recitations, followed by regular

examinations. It is believed that this course has been of real value, and could have been of far more value if the students in the first few lectures could have been brought to believe that this is a subject which properly belongs in a course in engineering.

Now this part of the curriculum has been again carried forward to the Senior year. It is hoped and believed that from now on this feature of the curriculum will be of much greater value to the students because the first few lectures will be delivered by successful engineers and business men who have in their work demonstrated the necessity, or at least the advisability, of such training. It is believed that the students will be ready to accept such testimony and act upon it where they would not do so if the advice were offered by professional educators or accountants.

As it is important that the first year's class should be impressed promptly with the practical necessity for such a knowledge of English as has already been spoken of, a few talks will be given to the entering classes to bring them into a more sympathetic and receptive mood toward this and all other non-technical studies included in the curriculum.

Generally the entering class in their wisdom are ready to denounce promptly as useless or out of place these non-technical studies; thus the sympathetic coöperation of the students, which is such an important element in the efficient teaching required in a full course of study, is not obtained, and the foundation is laid for many regrets to be experienced in the years after graduation.

FACTORY DEPRECIATION—THE PROBLEM OF CORRECT VALUATION

By

Ewing Matheson

The increased attention given during recent years to improved methods of factory administration has been largely stimulated by American example. The laying out of works so as to allow the most economical sequence of operations, the standardization of patterns, and the consequent facilities for repetition tools are all regarded now with much greater interest than formerly. Out of this has come the simplification of accounts, not only of material and labor, but also those relating to the distribution of stores. All these, together with the general charges pertaining to the business, afford a basis for estimating future expenditure and profit. But the allowance to be made for that wasting of the capital invested in the factory, due not only to specific wear and tear of the plant, but to many other causes as well, has not received all the attention it deserves.

No concern can last unless the cost of manufacture, which forms the basis of price, is charged with the wear and tear of the apparatus or machinery employed and includes also a provision for contingencies. Such a provision may, like premiums of fire and life insurance, press lightly if attended to from the first. In fire insurance the risk may never become a loss. In life insurance the loss, though long deferred, must come eventually, and so a factory plant must, at some time, cease to have any value worth keeping.

There are many differences of detail in the methods of depreciation allowance adopted by managers and accountants. In some cases buildings, machinery, and plant in the factory are treated as a whole; in others these three are classed separately, with a special rate of depreciation for each. A fixed proportion of original outlay may be written off yearly, or a percentage may be deducted on a continually diminishing value. The choice

between reserve sinking fund and depreciation is greatly assisted by special tables drawn up for the purpose, showing the different effects of the various systems and the annual charges necessary to each.

It is impossible here to enter into these and other methods adopted by auditors or skilled accountants in applying systems of depreciation, but it is possible, and may be useful, to enunciate the principles involved. If the main point be observed of allowing out of gross income for the contingency of decreasing assets, it is not of vital importance whether such allowance be carried out under the name of reserve or sinking fund, or depreciation. If thrift be exercised, one need not consider too closely the name given to it. While, however, the exact method is of secondary importance, it may still prove extremely inconvenient if any inappropriate system or designation be adopted, for it may mislead those who are not fully acquainted with the purpose of the plan and its effect.

Partners may have such various interests in an undertaking as to make the question of depreciation of great importance. A managing partner may be entitled to a share of profits equal to that of the sleeping partner who provides the capital. It is to the interest of the first to show good annual profits without an excessive provision for future contingencies, while the second may prefer to keep his capital intact by liberally writing down out of gross profits the nominal value of the plant. On the other hand, it may be unfair to the working partner who has only a fleeting interest to safeguard the future in which he has little concern by too liberal a writing down. There are methods, easily formulated by skillful accountants, by which this difference of interests may be met, such as by an occasional review, or by providing for revaluation if the partnership be dissolved.

A reserve is generally understood to be a fund available in case of need. If it is to meet some possible sudden contingency or to equalize dividends, it is important that the fund shall be liquid in money at call or in investments easily realizable; that is to say, available without delay. If, however, it is intended only to maintain the capital value of the concern, so that it can be

realized in money when the business is wound up or sold, then the reserve may, with prudent limitation, be invested in the business itself and applied to the purchase of land, erection of buildings, or in some other way to increase the manufacturing capacity of the works. If the existence of either kind of reserve be held to obviate the need for depreciation, and the original value remains undiminished in the inventory of plant, or annual balance sheet, then the designation is fallacious, for it might appear to those outside the management that the capital is intact, as well as the reserve, when really there is only one of these two available resources. Such an inference is natural even when the fund is entitled "reserve and depreciation."

While vague methods of providing for the future may be sufficient, though not wholly satisfactory, when only a few partners are concerned, they are not so in joint stock companies where numerous and different rights have to be safeguarded. In justice to all concerned, the annual account should show the correct position of affairs, so far as experience and foresight can elucidate them. There may be as much exaggeration in writing off as in neglect to write off, and either error may cause loss to those who are uninformed about it.

While in regard to buildings, plant and machinery, every branch of trade has its own special incidents so far as physical wear and tear are concerned, there are special circumstances of an entirely different kind which, from time to time, have to be considered and to which all kinds of enterprise are liable. In the great staple trades alterations and improvements become necessary which may render obsolete much of what stands in the books of accounts as of considerable value. Those concerns which have provided nothing for these contingencies by writing down or depreciating their plant, and for which the managers are unable or unwilling to provide new capital, must of need go under in the struggle with competitors better prepared.

As examples, the old-fashioned flour mills, sugar refineries and chemical works which brought regular profits to their proprietors thirty years ago have had to be reorganized and, to a large extent, reconstructed to meet modern practice. The manufacture of

Portland cement affords another example. The monopoly of the Thames and Medway Cement Works in England has been upset by Continental and American rivals, and only new expenditure on a considerable scale will bring them into line. One need hardly refer in *Cassier's Magazine* to the changes and improvements in the steel-making and shipbuilding trades which have affected largely the capital accounts. These remarks might be regarded as truisms whose recital is unnecessary were it not that so many old and respectable concerns have had to pay the penalty of ignoring them.

As new kinds of machines and plant are invented and applied, proper rates of depreciation can be evolved only as experience guides. As an instance, interesting questions are arising in connection with electrical apparatus and its depreciation. On the one hand, some of the materials used, such as bitumen, lead, vitrified conduits, and copper, may, if undisturbed, be deemed almost imperishable; others, liable to attrition or to rapid movement, or those exposed to wind and weather, may deteriorate quickly. During the transition period, till experience has shown the way, prudence will suggest a liberal provision not only for these physical causes, but to meet also the probability of new inventions rendering the plant valueless before it is worn out. In a period of twenty years methods of electric lighting have been entirely altered; tramways have been changed from horse traction to steam locomotives, then to cable haulage, and now a change to the electric underground conduit system seems likely to supersede many of the overhead electric trolleys so lately erected. There is a reluctance to acknowledge these risks in advance. Those who are concerned in new enterprises are assured by the sanguine inventor or engineer that finality has at last been reached, and that, in regard to renewals and depreciation, nothing need be considered beyond the mere physical wear and tear that attend all industrial plants.

A sinking fund is the form generally adopted for the recovery of capital invested in some asset wasting by the passing of time. As examples, leasehold property, patents having only a few years to run, or minerals which are becoming exhausted. If established

early enough, the annual provision of such a fund may be small and can be measured exactly. There are other and less tangible assets which are also of a wasting nature, such as good will. It has sometimes been argued, even with the support of experienced auditors, that to commence writing down the value of good will or patents immediately after they have been purchased would be an acknowledgment that too high a price has been paid for them. It might as well be said that if a short lease has been purchased it is not necessary to institute immediately a sinking fund to recover, at the end of the term, the capital so expended. It is true that while the duration of a lease is evidently limited, that of good will is speculative or unknown. Yet if in any branch of trade a retrospect be made of numerous undertakings profitable twenty years ago, it will be found that a considerable proportion of them have diminished or even ceased to exist, and that the good will if now sold would realize little or nothing. It is, however, right to mention that the courts have not always upheld the severer course here advised, for it has been decided in the case of a wasting asset that directors of a company are not bound to make a sinking fund, but may distribute their entire profits if they choose. The point urged here, however, is that candor and fairness should induce them to explain their course to all concerned.

The property in ships affords examples of both systems. The principal companies who own fleets of steamers owe much of their prosperity over a long period of years to their rule, rigidly applied, of writing down at a liberal rate the value of their vessels and of applying their revenue as net income available for dividend only when this charge has been met. According to this method not only are all repairs defrayed out of revenue, but vessels which may have cost £20 per ton are depreciated annually till they stand in the books at only £8—a price at which they can be sold, for the usual practice is to sell old or obsolete boats and to replace them by new ones of modern design. Unless the gross profits of the undertaking would bear the cost of such depreciation, the undertaking is not really profitable, and as the period within which steamers remain in the first rank seldom exceeds ten years, the rapidity of the change affords a convenient object lesson.

The less heroic method is generally found in the joint ownership of one or more sailing vessels or tramp steamers whose destinies are controlled by managing owners. The full income, after defraying current expenses, including marine insurance, is all divided as profit, each shareholder being left to provide as he chooses against the reduction in value and for the loss involved when the vessel is sold at one third or one fourth of its original cost. So long as the circumstances are fully known to all concerned, this system is as honest as the other, for the partners are aware that they have been enjoying only a terminable annuity.

In municipal undertakings, carried out by public borrowings, there is an enforced sinking fund in the statutory condition that the loans be paid off in a given term, ranging from about twenty to sixty years, according to the nature of the enterprise. Unless repairs and renewals are liberally made out of revenue, such a sinking fund may prove insufficient, for the plant may have become obsolete or worn out before the end of the term. The tendency is to still further reduce the term where the assets are of a doubtful kind so as to safeguard not only the interests of the lenders, but those of the ratepayers who are responsible for repayment. For instance, in the case of loans raised for the specific purpose of purchasing existing horse trams a term of fifteen years has been prescribed, and that portion,—often considerable,—of a loan applied to the obtaining an Act of Parliament or to other preliminary expenses has to be repaid in five years.

Those engaged in manufacture will often plead that depreciation systems, good in theory, are impossible for want of funds. In other words, the annual writing down of values is a luxury which must be confined to prosperous concerns and limited for others to good years when surplus or exceptional profits are available. Not only, it is urged, must wages and other obligatory outgoings be met, but those engaged in the management, whether servants or partners, must be duly remunerated, and there may be nothing left.

Obviously, if sufficient be written off every fifth year, the capital may be as well, though not so symmetrically, maintained as by annual adjustment, but, at any rate, no delusion should be allowed to remain in the books of account. Plant does not cease

to deteriorate because it has been worked without a profit, or even if it has been idle. If nothing has been set aside to meet the lessening value, the impoverishment is the same, though not so manifest, as if the more positive act of withdrawing savings from the bank had taken place. In circumstances such as these, shareholders must submit to the loss of income, and, when trade revives, must be content to forego some of the improved revenue till the capital of the concern has been restored. Whether they are bound to do so depends partly on the agreements of partnership or articles of association as were just referred to in the case of wasting assets.

Neglect of depreciation may, for a time, show no ill effects, especially in the early years of a newly equipped factory. Why should machines showing no signs of deterioration, and which perform their work as well as formerly, be written down in value? The young man of twenty-five sees little good in life assurance; he is as fit to-day as he was a year ago, and the matter will keep. He is, however, a year nearer his end, as he will find on inquiry at the insurance office, where the most robust health will not save him from the increased rate of premium due to his age.

Although liberal writing down of values may, in the books of account, show diminishing assets, the proprietors are none the poorer because of book entries. If unduly depreciated, the true value will revive in a new valuation. If a proper system of depreciation be inaugurated, it will be necessary at each annual review, in order to show assets equal to the invested capital and liabilities, to set aside some of the earnings of the year to make up for the depreciated value of the plant.

It is not necessary here to describe methods of bookkeeping. Due accord between the auditors and the works-manager, both experienced in such examination, will allow of a moderate, but sufficient, allowance. When the time comes for purchasing new tools it may be urged that they are to increase the output, and not to replace machines that are worn out. Even if this be true, the new expenditure will only balance the lessened value of some obsolete machine or plant which is almost always to be found in or about a factory. There are some machines that never wear

out. They may be so strong and heavy that the operations of working have no perceptible effect on them; they may even be special tools worked only a few times yearly. A slight change in the nature of the trade or improved methods of working may still further reduce the number of occasions when the old machine can be used. Is it to be supposed that in case of liquidation such a machine will have any considerable value?

Portentous changes are looming over many engineering works. The importance of fuel economy is growing. If, as is already demonstrated, the modern gas engine is to afford power with one half the fuel consumption of the best steam engine and at one fourth the average consumption in the average factory, where are the funds to come from for the gas producers and gas engines if the steam engines, boilers and chimneys, which must perforce be discarded, stand at a high value in the books?

THE COMMERCIAL SIDE OF ENGINEERING

By

Walter M. McFarland

The question of how much a machine, or structure, or engineering work will cost, and whether it will pay, is almost always the one which decides whether it will be undertaken or not. Important as this point may be, it is often neglected by engineers of the very highest ability, so that among well-informed professional men it is very common to hear it said that the works of certain engineers are always sure to be the very best, but that they need a gold mine back of them to pay for the designs.

One often hears people say, laughingly, "The best is good enough for us"; but it may be questioned very seriously whether in engineering we might not, with reasonable limitations, reverse this and say that "good enough is best."

As illustrating this last point, a monumental example was the great Ferris wheel at the Chicago Exposition in 1893. The particular point is with respect to the way in which the wheel was driven. The wheel was about 250 feet in diameter, and an ideal way to have driven it would have been by a worm, which would have made the motion absolutely smooth; but the cost of cutting worm teeth on such a huge wheel would have been absolutely prohibitive. Another method would have been by a wire rope drive with a drum on the shaft; but this latter was about 150 feet up in the air, and if the rope had chanced to break the unfortunate passengers would have had to stay in the cars until repairs could be made.

Mr. Ferris devised a very much simpler plan, which many may have considered extremely rough; he made the device a huge sprocket wheel by notching the rim when it was cast, and it was driven by a sprocket chain down on the ground, where the parts could be constantly watched and inspected, and if anything did go wrong, repair could be made almost immediately. As a matter of fact, it is believed that there was never any accident to

the driving gear and that people were never troubled by having to remain in the cars.

Several years later another wheel, even larger than the one at Chicago—about 300 feet in diameter—was set up at Earl's Court, in London. The engineers did not believe that "good enough is best," but put in a wire rope drive. The rope broke on several occasions, and people were compelled to remain in the cars from twelve to sixteen hours. To the writer, Ferris' engineering appears first-class; it accomplished the object satisfactorily and cheaply, and was an entire success.

Another instance of what may be considered commercial considerations as affecting pure engineering was in the case of the machinery of naval vessels during the American Civil War. Mr. Isherwood, who was then engineer-in-chief of the United States Navy, was one of the greatest engineers whom America has ever produced, and was, indeed, a leader in the scientific appreciation of the true thermodynamic conditions connected with steam engines. He appreciated very much better than almost anyone else at that time the economic limitations of expansion, so that the action he took with respect to the engines he built was with full knowledge of what he was doing. The engines which he turned out were extremely heavy, and have been criticised at times by ordinary designers for this supposed defect, as well as for the use of only a very moderate range of expansion. The engines were made heavy because the increase of the navy created such a demand for engineers that it was impossible to supply an adequate number with thorough training, the consequence being that the machinery often went into the hands of quite unskilled people. Far more important than any question of weight was the vital one of being certain that the machinery would not break down. This was why the engines were made so very heavy, and, as a matter of fact, they did not break down.

The reason for using only a very moderate degree of expansion was to secure simplicity of valve gear; a higher ratio of expansion also would have meant very much larger and heavier machinery. It required a good deal of courage on the part of an engineer to go counter to prevailing views and general ideas, but

Isherwood's machinery admirably filled the purpose for which it was designed.

Another illustration of the effect of commercial considerations on engineering design is shown by a comparison of the application of forced draught for boilers in war vessels and in merchantmen. In the former the full power involving maximum forced draught is used only occasionally, perhaps not 1 per cent of the time the machinery is in operation, while in the merchant service the engines are used at full power almost the entire time. In war vessels weight and space are extremely precious, so that questions of economy receive minor consideration. The result is that in war vessels both engines and boilers are designed for good economy at about full power under natural draught, the consequence being that the boilers, as well as the engines, are too small for economy under forced draught. This is thoroughly appreciated by the designers, but to provide engines and boilers which would give high economy under forced draught conditions would necessitate probably 25 per cent more space and weight, which are simply inadmissible; and, further, the machinery would then be so large that it would be very uneconomical at cruising speeds.

In the merchant vessel, as the conditions are uniform and full power is demanded all the time, both engines and boilers are designed for maximum economy under these conditions, and as weight and space are not so precious there as in the war vessel, the proportions can readily be made adequate to the desired result.

The effect of commercial conditions is also seen by comparing the Atlantic express steamers with cargo steamers for very long voyages, such as from England to China and Australia. In the express steamers very high speed is demanded by the traveling public, who are prepared to pay for it, so that while a fair degree of economy is desired and obtained, it would not pay to go to the complication which is reasonable for the long-distance service at slow speed. As showing what is necessary to get these extreme economies, reference may be made to the steamers *Inchdune* and *Inchmarlo,* which have given a horse power for slightly less than one pound of coal. These vessels used super-

heated steam, a tremendous ratio of heating to grate surface in the boilers, and numerous appliances necessary for the utmost economy, but these made the machinery very heavy and bulky for the power developed. As the total horse power of these vessels was not very great, it was practicable to resort to these measures, particularly as the increased space and weight for the machinery would be compensated for by the reduction in bunker capacity needed for the very long trips which they make. In the case of the Atlantic express steamers, however, whose trips between terminal ports do not exceed a week, and where coal is abundant and cheap at both ends, it would not be good commercial engineering to adopt all these economical appliances with the attendant complication and possibility of derangement, because in these vessels high speed and absolutely reliable passages are more important than economy.

One does not hear quite so much about it now, but from ten to twenty years ago American railway practice was much derided by British engineers. The roadbeds, bridges and rolling stock were all said to be absurd, and the splendid stone bridges and finely ballasted roadbeds of the British railways, and their locomotives which would, with care, run forever, were held up as examples to follow. Anyone, however, with an open mind, and especially if he believed that the motto "good enough is best" was worthy of some faith, would have seen at once that there was a tremendous difference in the circumstances surrounding the two cases. In Great Britain there were short distances and a dense population, and wood was relatively expensive. America was a country of magnificent distances, a sparse population everywhere, and an exceedingly scanty one in many places, and with a superabundant supply of wood. If the railways were to pay at all, they must be built cheaply and with low-priced materials. Hence, the rough track equipments and the wooden bridges. As time has gone on and the country has become more thickly settled, and the price of steel has enormously decreased, we find very much better roadbeds and steel bridges taking the place of wooden ones, while in some cases stone bridges are also used.

With respect to the locomotives, American engineers are not

yet willing to admit that the British engines are better, although they certainly do last longer; but that is largely due to the different points of view of railway management on the different sides of the Atlantic. American managers believe in working the locomotives "for all that is in them," with the idea that if a locomotive lasts ten years that period will have sufficed for important improvements which would relegate it to an inferior position, so that if it is worn out in ten years it may be thrown away and a new one put in its place.

The effect of density of population on engineering design is seen also in marine work. Even slight attention to the shipping in the Atlantic and in the Pacific Oceans will emphasize the fact that the very fast steamers are in the Atlantic and ply between New York and the ports of Great Britain, France and Germany. Indeed, for a long time it was the custom when a vessel was superseded for the Atlantic service to send her around to the Pacific. The reason for this is quite evident to anyone familiar with the cost of high speeds. These are impossible commercially except in very large steamers, and even there they mean a tremendous expenditure in first cost for hull and machinery, while the cost for fuel and wages is also very high. Meeting all these costs is possible only where there is a very large and constant passenger traffic, and obviously this occurs only between New York and the principal ports of Western Europe. In the Pacific the distances to be traversed are about twice as great, and the number of people who can afford to pay the price of high speeds is very limited.

A great many things affect the development of any industry, and it would seem that results sometimes come about rather indirectly. Besides the large, very fast passenger steamers in the Atlantic, there has lately grown up a class of vessels, some of which are the largest afloat, but which run at much slower speeds, such as the *Celtic* and *Cedric,* of the White Star Line. Chronologically these ships came after the big express steamers, and it would seem that they are the result of two commercial considerations, one, that the number of very high-speed express steamers which could be supported is limited, and the other, the scientific

fact that it is much cheaper to transport cargoes in very large vessels than in small ones. In addition to the fact that it takes a smaller power per ton of displacement to get the same speed in the large vessel, the weight of machinery and of fuel is a smaller percentage of the total displacement, so that a ton of total displacement may not only be transported for less, but this ton of displacement has a larger fraction of useful load carried. A point in connection with this, of slight historical interest, which those who are of an antiquarian turn of mind may look up, is that some twenty odd years ago a tonnage law was enacted in Great Britain which provided that, in reckoning the tonnage for dues, there were certain exemptions on account of spaces occupied by machinery and other things. Some clever constructor, in studying over this matter, found that by modifying the design of the ship the amount of useful carrying capacity could be considerably increased without increasing the measurements on which the dues were fixed. This led to an actual change in the design of a great many vessels purely on this account. Considered as pure engineering, this change was bad. This is not a point worthy of commendation, but it emphasizes the important effect which commercial considerations have on what might otherwise be considered a purely engineering matter.

While discussing steamships, attention may also be given to the special type of vessel employed on the western rivers of the United States, the stern-wheel boat with engines that are considered archaic by engineers whose experience has been on the deep waters of the ocean. This type of boat is mainly engendered by the conditions which it has to meet, but the commercial aspect here also is important. The engines are non-condensing, and seem to defy all the usual laws of economy; but coal in the localities where they run is generally quite cheap, and the dangers to which they are exposed from sand bars, snags, etc., are very great. Indeed, it is usually anticipated that their lives will not be very long, and consequently it is necessary to build them just as cheaply as possible. It is interesting to note, in connection with this, that Stanley, in his book, "In Darkest Africa," has a good deal to say about two boats used in his expedition, one a

stern-wheeler, and the other fitted with propellers. Stanley was not an engineer, but his comments show the difference in adaptability of the two types. The screw boat was nearly always in trouble, while the stern-wheeler gave very little.

There is, in the case of the *Great Eastern,* a monumental illustration of the fact that a machine or structure may be almost perfect from the purely engineering side at the date of its completion, but a failure commercially. She was, for more than a generation, the criterion as to great size in steamship construction, although she has been surpassed by a number of the great steamers of to-day. She was a failure commercially because she was built long before the days of economical engines, and when it is considered that to make about sixteen knots her coal bunker capacity was about 10,000 tons, while the modern flyers have nearly half again as much speed and carry only about half as much coal, one of the reasons for the failure may be appreciated. It is probable also that the weight of her machinery to make sixteen knots was as great as that of the modern flyers to make nearly half as much again.

In stationary practice it will often be found true that the most economical plant in steam and coal per horse power may not necessarily be the cheapest to use. In a certain case, the specifications called for a plant with the avowed intention of getting the utmost economy in the production of power. The plant has been built and is a great success and a beautiful illustration of fine engineering. In this particular case the purchaser did not have to consider the question of interest on first cost; but had the plant been for an ordinary industrial establishment it would really not have been the best engineering, with commercial considerations taken into account. Indeed, a very much cheaper plant would have answered the purpose, and an analysis of the data indicates that a plant which would have used half a pound of coal per horse power more than this economical one could have been put in for enough less in first cost so that the interest on the saving would have much more than counterbalanced the increased cost of coal.

Commercial considerations are constantly at the front in elec-

trical engineering. This is the day of transmission of power over great distances by means of electric currents generated by water power in distant places. The question which confronts the designer from the very start is the cost of copper. He is not permitted to choose a size of wire for his transmission solely from electrical considerations, but he must ever bear in mind the effect of the investment in copper on his interest charges.

Only recently in one of the leading electrical journals a frank discussion appeared of a case where it had been proposed to establish a power plant near some coal mines and transmit the power forty or fifty miles to the place where it was to be used. It happened, however, that the country between the two points was quite level, and there was already a railway, so that it was found, on balancing the costs, that it was cheaper to haul the coal from the mines and have the plant near the place where the power was to be immediately applied.

A discussion has been going on for some years as to the possible displacement of the steam locomotive by electric service, and there is at present by no means an agreement as to just what the outcome will be. Enthusiasts on both sides can figure out results to suit themselves, but the present outlook seems to be at least settled that for branch lines electricity is almost certain to supplant the locomotive. However it may be with the great trunk lines, there has been a remarkable development of interurban electric railways which either traverse regions which the steam roads have neglected, or in many cases parallel the steam roads at a very short distance. The curious thing in the latter case is, that usually, without any falling off in the traffic on steam roads, the electric roads are able to carry a very much greater number of passengers at a decided profit. This seems to be an instance of the commercial aspect of the case being met better by the electric system than by the locomotive. It is obviously uneconomical to haul a single car by a steam locomotive, but it is quite the reverse with running single cars electrically. This enables a very much more frequent schedule to be given by the electric road, and a service which, on the whole, is very much more convenient and satisfactory.

Referring again to the point that "good enough is best," meaning that what will answer fully the requirements of the case is best, even if in itself not the highest product of the art, we may consider the case of certain manufacturing conditions. There are lines of manufacture where the principal use of steam is for heating rather than for developing power in an engine, although engines of considerable power are needed. Now, as is well known, the total heat of exhaust steam is but little less than that of the live steam from the boiler before admission to the engine, so that for heating purposes it is just as useful. This idea has been utilized by taking the exhaust steam from the engines instead of live steam from the boilers for the heating necessary about the works. In many cases the amount of steam necessary to produce the heating effect is considerably greater than would be supplied by the exhaust of a very economical engine, so that in such cases it is decidedly better engineering to use a cheap and wasteful engine, as far as steam economy is concerned, rather than an expensive and economical one. Speaking roughly, the power of the engine is obtained for nothing, so that this really does not enter as a factor at all, and consequently the cheapest engine which will do the work is the best one to use.

There are cases also where steam is used direct from the boilers for heating purposes and where the question comes up whether to use a cheap boiler which will make wet steam or a highly efficient boiler which will make very dry steam. In ordinary work, for use with an engine, the latter is, of course, the one to be chosen; but where all the steam is to be used for heating, the cheap boiler that makes wet steam is the better.

An interesting case where the commercial aspect should be the deciding one is that of steamships for ice breaking only, in the harbors where there may be only a few days in the year when they are used. It must be obvious on a little consideration that steam economy in such cases is absolutely unimportant, and that the first cost of the plant is the thing which should rule. This, of course, means that the cheapest machinery which will do the work, and be reliable, is that to be chosen.

The machinery for waterworks pumping engines offers a field

for consideration of the commercial aspect. If the pumps are located in a district where coal is very cheap, it is easy to see that elaborate refinements to secure great steam economy may represent a financial loss, while on the contrary, where coal is high, it pays to get the most economical machinery. In other words, the engineer when scheming his general plan of machinery ought to make up comparative statements which would include not only the cost of fuel, but the interest on first cost, and allowance for depreciation, repairs, etc. The machinery which represents the lowest aggregate of these annual costs will be that which is best to use.

We have already considered one particular in which the commercial aspect of the case has a strong bearing in electrical engineering, but it is probably safe to say that in almost every case of the use of electricity this commercial aspect requires careful consideration. This is for the reason, speaking broadly and roughly, that electricity, as such, cannot be stored. Of course, we have the storage battery, but we cannot store electricity as we do gas or water, for example. The result of this is that the capacity of a station must, in general, be great enough to answer the maximum demand upon it, and thus the nature of the load and the relation of the average to the maximum load have a vital importance in fixing the rates to be charged for current. Where the load is entirely for lighting, the maximum demand lasts for a short time only, so that for the bulk of the twenty-four hours the plant is running at only a fraction of its full capacity. This means that the rates charged must be high.

If the plant is in a district where there is also a great deal of manufacturing, a day load may be obtainable which will materially raise the average load and may permit a lower rate to be charged for lighting. In any case, the rate for power can be made much lower than for lighting, so as to induce consumers to take the current. This matter has been given the most careful consideration by all central station managers, and has led to the design of what is known as a maximum demand meter, which records not only the total amount of current used during the month, but the maximum amount used at any one time. It is

obviously only fair that the charge for current should be based partly on the capacity which the consumer requires, as well as on the amount of current he actually uses, and the rates are so adjusted that, for the same total amount of current taken, the price is much lower when the maximum demand is low than when it is high.

The storage battery is used in many cases of a fluctuating load to tide over the peak and thereby enable a smaller investment in engines and generators to accomplish the same result. Storage batteries are, however, expensive, and of relatively short life, so that while offering a solution, it is not a wholly satisfactory one.

An interesting illustration of the effect of commercial considerations was recently brought forward in connection with a scheme for a long-distance power transmission plant in Mexico, where the success of the scheme depends on the combination of an almost constant day load for a long period with a lighting load. It was proposed to install a power plant at a waterfall more than a hundred miles from the City of Mexico, which would supply current for the lighting of the city for about five hours every evening. During the other nineteen hours it was planned to utilize practically the entire power of the plant for the service of one of the railways. There are a number of commercial considerations in this case, one of which is the high cost of coal in Mexico; but it is obvious at once that it would be commercially impossible to transmit current more than a hundred miles for lighting alone. It is also interesting, in connection with this question of the effect of a constant load in making low prices possible, to notice the result of the installation of the great electric plant at Niagara Falls. When first started, the current was used chiefly in Buffalo and for the railway between Buffalo and Niagara Falls; but gradually an industrial community near the falls has been developed, for the reason that a number of electrolytic industries which take an absolutely constant amount of current for the whole twenty-four hours, have found it economical to locate their works within a short distance of the power plant. To these concerns the cost of power is the most important element, and as they give an absolutely constant

demand, the power company can afford to make very low rates for them.

One of the features of this age of close economies is the manufacture of articles in standard sizes and strictly to gauge so that the parts are interchangeable. This is a case where pure engineering and commercial engineering often conflict. To manufacture cheaply it is absolutely necessary to manufacture in large quantities, and obviously this is possible only when standard sizes alone are made. This means that when the design has been completed and the patterns have been made the rest is repetition work, and the cost of this preliminary work can be distributed over a large number of units.

The tendency of pure engineering is to get out a design for each particular case that arises which will be the very best for that particular case, considered from a purely engineering standpoint, and without regard to cost. It is almost invariably the rule, however, that the special designs or the special sizes required will make the cost of the installation considerably more than if it had been made up of standard units. There is another side also to this question, namely, that standard sizes represent matured experience. When the first units of a new size or design come out, the manufacturer watches them carefully, and if any defects develop or if any points arise where improvement is possible, these will receive attention. After a short time, barring radical developments in the line of work, the design is as good as it can be made. If a consulting engineer either gets out a new design, himself, or wants the manufacturer to get out a new design, there will certainly be some features which are, to some extent, experimental, so that the new machine, made exactly to fit the particular circumstances, is hardly deserving of the same confidence as the standard one.

One of the most notable illustrations of the benefit of standard sizes and standard methods of work, because it created such tremendous excitement in Great Britain, was the contract for the Atbara bridge in Africa, which was obtained by the Pencoyd Iron Works of Philadelphia, in competition with the world. The bridge was needed in connection with Kitchener's operations

against the Mahdi in Africa, and it was highly important that the structure should be completed in the shortest possible time after the tenders were asked. Owing to the system with American bridge builders of putting up standard spans, all parts of which can be quickly manufactured and are sure to go together properly when delivered at their different destinations, the Pencoyd Company was able to guarantee a time of completion very much below anything which was offered by European manufacturers. The bridge was actually completed somewhat within the time they had guaranteed.

European practice for bridges has been to consider each case by itself and arrange for the number of spans, their length, etc., just as if duplication of previous designs were not to be considered. From the standpoint of pure engineering, without regard to commercial considerations, this would probably be the best way; but there is no question that the American method gives a cheaper bridge which fully answers the requirements, and which can be delivered and erected very much more quickly.

One of the special advantages of building standard sizes is that repair parts can be obtained promptly and cheaply. In some lines of work this is a matter of vital importance, because from the nature of the service the machines do not get very frequent inspection, and when anything has to be replaced it must be done quickly. Where the machines are standard, the manufacturer, as part of his regular work, always has quantities of all the individual parts in stock, so that he can ship them upon receipt of a telegraphic order. Where the machines are special, he cannot, of course, afford to keep spare parts in stock on the chance that an order may come some day; this would represent the locking up of too much money if the plan were carried out on a large scale. This same objection applies to the purchaser keeping spare parts in stock, for it represents the locking up of his money. Where standard machines are bought, there is every benefit to the purchaser and with a minimum of cost to all parties concerned.

There has been, as we know, ever since machinery existed, a constant tendency to replace hand work by machine work, and while this sometimes means temporarily throwing out of work

men who have been following the old line, it undoubtedly assures progress in the long run. Indeed, in many cases it is easy to see that it has saved men from extremely laborious and dangerous occupations, in such work, for example, as charging blast and steel furnaces. While the carrying out of this idea is largely a matter of invention, nevertheless opportunities come to almost every engineer to do something along these lines himself. But here again the commercial aspect sometimes gives the intelligent designer an opportunity to show that the engineer appreciates costs as well as the manager. It may happen, and such cases have actually occurred, that the first idea of doing a piece of heavy work would be on some large machine, but by a slight change in design the same result can be accomplished by hand work; not, indeed, the same work, but the same end. The actual amount expended in wages may be slightly greater, but the use of a large and expensive tool is obviated and this tool is left free for other work.

Too much attention cannot be paid to the great benefit and strength in the work of design which come from an intimate knowledge of shop processes. The best design is not the one which looks neatest on paper, but the one which, while accomplishing its intended result, can be manufactured most cheaply. A knowledge of pattern-making and molding will thus often enable the designer to provide for reasonable and proper changes in sizes with very little additional expense for pattern-making.

The same is true about machining. Not every shop can afford to have a great bed-plate with portable tools such as have been installed in some large works, and it frequently happens that even heavy work must be set for various operations. If the designer bears in mind that often the cost of setting the piece properly is as great as doing the work of machining on it, he will look out that the surfaces to be planed, the holes to be drilled, etc., are so arranged as to cause as few settings as possible.

When saying that an engineer might almost take as his motto "good enough is best," emphasis must be laid on "enough"; in other words, he must provide adequately for the work to be done. For example, it is worth while to have the materials that come to

the works carefully inspected to see that they actually are all that they are claimed to be. Even from the very best establishments materials are sometimes sent out that prove defective, and it is only after the defects have been found that it is realized that they should have been given a more thorough inspection.

It is worth while to take advantage of opportunities to get familiar with the processes of manufacture and with what might be called the capabilities of the market in lines not immediately connected with the work one is doing at the time. People do not always stay in one place, and the information thus acquired may be of great value elsewhere. In one case the superintendent of a large factory saved for his employer at least $50,000 a year through familiarity with other shop practices. Believing, as a consequence of this knowledge, that he might get some of his material more nearly finished than it had been previous to his taking hold of the matter, he took the question up with the manufacturers of the material, who acceded to his proposition almost immediately, with the saving mentioned.

The young engineer should begin at an early day to familiarize himself with the question of costs and become as proficient in this subject as possible. This does not refer merely to costs of material nor even the cost of doing work in the shop, but to all the elements that go to make up the cost of the product as it leaves the factory. We must all realize that the price which is obtained for any article must include not only the cost of the material and of the labor spent on it directly, but of the indirect labor necessary for the production of power and light, as well as the cost of police and repair of buildings, the salaries of engineers, draftsmen, salesmen and of the officers of the corporation. It is important to acquire familiarity with all these matters, because it may often happen that, when a question of reduction of expenses comes about, unless the matter is thoroughly understood, the pruning knife may be applied in the wrong place.

Articles discussing factory cost in technical papers and magazines have a good deal to say about the relations between direct and indirect labor; but it must be noted in studying this subject that the distinction between the two is, of necessity, very largely

arbitrary and based upon convenience and the nature of the business. It would seem at a hasty glance that in a business where the percentage of indirect to direct labor is less than in another it would mean greater efficiency, but this by no means follows. It is sometimes very difficult to charge certain kinds of labor directly to particular orders, and for this reason it is classed as indirect.

For example, the tool manufacture and repair department of a large works will serve a large number of workmen employed in direct labor, and without a considerable amount of accounting it would be difficult to charge the cost to each particular order. The same is true of crane service, the services of the janitors, watchmen, etc. Then, again, it is easy to see that the expenses for drafting and pattern-making are sometimes difficult to properly allot. The immediate work in the drafting room and pattern shop may be for the first few machines of what are intended to be standards, and if this expense were charged entirely to the first few machines it would make their cost almost prohibitive. Hence, in many cases, this work, which is in the truest sense direct labor, is, nevertheless, classed under the head indirect. Attention is called to this point in order that, when studying this subject, there may be no mistake owing to making a comparison between cases which are not strictly comparable.

A gentleman of great experience in manufacturing recently told the writer that he believed accurate cost keeping was very much less common than was ordinarily supposed, and that he had had opportunities, in competitive bidding in which his firm took part and where they knew from experience the absolute cost of the work, to observe that competitors were taking work materially below cost; in some cases it actually led to the failure of the firms who had made the mistake. There is a great tendency in many places where the work done consists of building rather large machines of varying sizes instead of repetition work on smaller things, to submit proposals necessarily based on estimate. Unless there is a careful system of costs, these estimates in many cases are merely guesses.

Instances are common where estimates are based simply on a

price per pound of machinery, predicating these figures on prices for which other contracts had been taken on machinery whose weight was known. This is the very roughest kind of work, and it should never be done if it can be avoided. The reason probably for not having accurate costs is that it is expensive to establish an accurate cost system; but it is easy to see that when business is carried on without an accurate knowledge of real costs it is quite possible for a single error in estimating to involve a loss greater than the expense of a proper cost system for a great many years.

Along with the matter of costs, and closely allied to it, is the question of factory organization. With the present tendency towards large works the organization becomes very complex, so that it is really a huge machine, and just as we study to make all the parts of an actual machine work together harmoniously and for the utmost efficiency, so the same must be done with a great industrial organization. So important has this become that there are single experts and firms of experts who make a specialty of devising systems of organization, and while these experts can render valuable assistance in almost any case, the competent manager should be able to outline to them what is needed, leaving to them the elaboration of details. The experts have the advantage of experience gained from many lines of business, while the manager ought to know his own business more thoroughly than any outsider possibly can, however expert he may be.

In the old, easy-going days of works organization there was too great a tendency to have high-priced men doing small work of a clerical nature, in addition to the main work for which they were employed, the idea being, apparently, that only a little of their time would be taken. With the modern methods the clerical work coming upon the foreman's office is quite large in amount, and if he had to do it himself it would mean that he would have to neglect, to a great extent, his real work. Most of this clerical work can be done by a boy or young man at very moderate expense, and it is true economy to relieve the foreman as far as possible of this clerical work so that he can give his time to actual production.

This applies also in the drafting room. At some of the large works there are in the drafting room several hundred employees, and of this number about 20 per cent are clerks and office boys. It is found very much more economical to have a boy who is paid $35 or $40 a month run after drawings and blue prints and attend to filing them than to have this done by draftsmen who are getting $150 or $200 a month.

Every engineer is now familiar with the fact that in all modern works of any size the making and repairing of tools is managed by a special department of the works. The "good old days," when a gang of men would stand in line waiting for their turn at the grindstone, have gone by. In a modern shop, when a tool needs grinding, it is sent to the tool department and another one, all ready for use, is obtained at once. It is easy to see how much more economical such a method is, for the preparation of tools is kept in the hands of people who are doing nothing else and who are necessarily much more expert than the general workman would be, while the latter does not waste time in waiting for a turn at the grindstone. Indeed, where the premium system of payment prevails, a workman would not be willing to wait for a turn to sharpen a tool, because that would mean lost time to him. The great benefit of the premium system is that it prevents lost time by making the men see the advantage to them of so arranging matters as to have no "loose ends." The increased production does not mean harder physical work on their part, but more intelligence applied to the work.

ADDRESS TO THE CLASS OF 1903

By

Charles F. Scott

A significant condition exists in the field of technical education. Scientific and engineering courses, both in schools of technology and in universities, mark the great evolution in modern education. Although the facilities for this new kind of education are constantly increasing and expanding, yet the number of students increases faster than funds and equipment. Notwithstanding this, graduating classes of increasing size are insufficient to meet the demands for technically educated young men.

What are the conditions which have placed a premium upon graduates in engineering and have opened new opportunities to the young engineer? A general view of the situation is contained in a letter, which I recently received from an engineer whose distinct, though wavy, writing marks him as well past the meridian of life, which contains these sentences:

> "At the Philadelphia Centennial, twenty-seven years ago, we were all asking, 'What will the next one hundred years witness?' It has witnessed already more for science, engineering, and humanity than all that has been accomplished before, and is now in the throes of yet greater things, which it is developing with yet greater energy."

We who are younger have become so accustomed to accelerating progress that we do not have the perspective by which we may appreciate the change which has taken place. But a new era has come. We live in a new civilization. It is the result in no small degree of scientific discovery and its application. I will not recount the steps which mark the evolution of the past century, nor will I indicate precisely how "the engineer, one skilled in the application of materials and forces of nature to the use of man," has been a prime factor in the evolution from savagery to civilization. The change from the stage coach to the express train, the hackney coach to the electric car, the shoemaker's bench

to the great factory, is illustrative and typical of the new order of things. Find, if you can, a single important material element in your daily life which has not in some way been vitally affected by the work of the engineer. The books we read, the food we eat, the clothes we wear, the houses we live in, our methods of heating, of lighting, of water supply, of travel, of communication, have all been transformed since the days of our fathers.

It would be interesting to consider in detail the specific ways in which the development of different phases of engineering work have been effective in accomplishing useful ends. It is of interest also to generalize in order to determine the particular process, if such we may call it, by which engineering promotes progress. Consider first the methods by which the newest branch of engineering has become so effective. The result of the application of electricity may be summarized by saying, Electricity increases efficiency. The electric motor, for example, does little which may not be done by other means, but it propels cars, it operates cranes, it drives machine tools and printing presses more conveniently, or rapidly, or cheaply, in short, more effectively than other agents. By reducing time and cost and increasing output it increases efficiency. In the same manner the great result of engineering is this, *Engineering increases efficiency.* It provides the instruments and the means and the methods by which the results of human activity are enormously increased. It increases the work a man can do; it increases the wealth a nation can produce; it increases comfort and well being; it gives larger and broader life. The building of a new bridge, or of a larger or more efficient engine, or of a more convenient office building—these are not merely individual things to contribute to the convenience of a few persons; still less are they to be considered merely as the means by which the engineer or the builder may derive remuneration. They are part and parcel of the great mechanism, of the intricate machinery of our modern life and they are as essential to its existence and its prosperity as are the buildings and power plant and tools in a great machine shop to the workmen who are making locomotives. Consider it in this light. young men, and the profession you have chosen is one whose calling is high and

whose responsibilities are large. Do not lose sight of this broader view, do not become so absorbed in minutiæ or in details that you miss the inspiration which comes from realizing the part which your profession and your work is to fulfill in promoting onward progress, for we are now "in the throes of yet greater things."

A recent experience has particularly impressed me with the new rate of acceleration of the times in which we live. I have been privileged to visit Oxford's classic halls and to walk across the greens of Cambridge and beneath the line of overhanging limes. It is a wondrous presence—to visit these nurseries wherein for centuries the flower of England's strength has been nurtured and the thoughts and the ambitions which have made Anglo-Saxon greatness have had their birth.

To me there was one thought preëminent, even to me, who spent his early years in an old university, the oldest in the Northwest territory—it was the pervading sense of the ancient, the unchanged. Here were buildings dating back beyond the days of Columbus' voyage, here were halls and cathedrals bearing the insignia of kings and queens and heroes of England's history so far back that history almost merges into myth. Yet it all stands to-day as it might have stood then. One can imagine that Addison has just preceded us along the walk which inherits his name, or that Newton has just entered the door which has been indicated by the friendly Baedeker. The past is preserved, one sees scarcely an anachronism. Outside the walls there may be an occasional tram car or the electric light may dispel the old-time darkness, and down this little street with its peculiar turns and curves there are laboratory windows where the sight of test tubes and of dynamos may jar upon one's classic musings, but they are so exceptional that they are like the glimmering candle that intensifies the gloom. Pass on a square, enter another portal and there is nothing to dispel the dream that you have been transported back for half a thousand years.

If I return to my native Ohio and visit the institution nearly a century old, at Athens, and then my younger Alma Mater at its capital city, I do not feel at home, they are not familiar, for in buildings and facilities and faculty and students they have more

than doubled, they have twice doubled since I, who still count myself a young man, stood upon the campus on a beautiful June day to receive a diploma. The advance which a decade now records is greater than that in centuries of the past. Let us beware lest the thoroughness and the strength of the old enduring plan with all its charm which softens life are not lost in the new methods of the strenuous present.

You are going forth to take up your part in the world's work at a time when the work of the engineer *per se* has attained new magnitude, new importance and a higher rate of advancement. It is at a time also when social and industrial affairs are in the midst of great changes and at a time when the work of the engineer is most fundamentally and intimately related to these great movements. The very conditions which underlie modern life, such as railroads, steamships, manufactories, power transmission, the construction of modern cities with concentrated, intensive social and business activity, all these come from the engineer. Modern coöperation, social, industrial, commercial, financial, are all the outcome, the results of the conditions which have been forming and crystallizing as the results of engineering work. Hence, the wider range, the greater responsibilities, the larger life of the present and the coming engineer.

One of the important phases of the new order of things is the aggregation and combination of industries and of capital which characterizes every branch of business. It has been asserted that this is subversive of individual independence, that it restricts individual aspiration and advancement, that it is a dark cloud on the horizon of the college graduate.

I have seen recently an extract from an address by Mr. James B. Dill, at the University of Minnesota, which deals with this question. He said:

"I believe that the tendency to organization, to combination, has put a demand on the college trained minds, has put a premium upon the services of such men and has made it easier than formerly for the college graduate to get started and to succeed in the world. . . . . The college man has come to the front with his trained mind and his trained body and to-day is pushing off the throne those men who have not had the advantage of college training. When the trust movement shall have steadied itself, and

when it shall have eradicated those tendencies which are, apparently, in the wrong direction, when it shall have increased and strengthened those elements which are right, then the men in charge of the great combinations and in executive positions will be the men who not only have a knowledge of the business, but whose minds have been broadly trained and whose characters have been formed within university halls. The situation demands the employment of college men."

The new method by which things are done on a larger scale calls for men of broader faculties, higher intelligence and ability. Larger things require larger men, larger undertakings open larger opportunities.

There is another aspect of the modern movement in which the tendencies are not so clear. We know that civilization and co-operation go hand in hand. We recognize the fundamental economies which are the inspiration and the justification of the corporation as a financial and industrial institution. It is coming to be generally believed that in so far as its financial and commercial and engineering aspects are concerned, the trust is sound in theory, and that if it fail it is not because of wrong principle, but through misuse and abuse of that principle. But there is an element in the problem aside from that of finance, aside from that of engineering and of production, it is the human problem—the problem of the relations between men. I apprehend that there is a general feeling that the large corporation is not theoretically sound from the social standpoint, that although it may lead to economies in production it does not conduce to general individual advancement and personal freedom. It is felt that the tendency is to elevate a few leaders and to group men into masses and to treat them in the aggregate and not as individuals.

As engineers our training and experience teaches us that what is correct and sound in principle may, with favoring conditions and skill, be made successful in practice, and also that what is in principle unsound must sooner or later make way for something new. It is fitting, therefore, that we should first determine what is the correct principle, the ideal thing in the movement toward combination, and then work toward that ideal.

Let me quote in this connection from an address upon "Man-Power," recently delivered before a club of young engineers in

a manufacturing company by Mr. T. C. Frenyear. After referring to the democratic movement of recent years, the question is raised whether large organizations under the control of a single person are compatible with the freedom which a democracy should guarantee. After indicating that the word king originally signified the man of exceptional ability, the man who *can,* the address continues:

"In democracy there is still just as much need for 'the man who can,' but he is no longer called king, and he is selected by natural, not artificial, processes. . . . . We must have rulers, men of power, and they are selected not primarily by our ballots, but by the inevitable cosmic processes of evolution. . . . . What is the true principle of organization in a democratic community? It is this: Getting others to do what you want done while they are doing what they themselves wish to do; inspiring others with a desire to do what you want done, not driving them to do it. This may seem to be only a new form of slavery, but such organization develops men, brings them into effective relations. It is like building a useful and beautiful house of stones and bricks, by themselves of no use and little beauty. This organizing ability is a matter of power and may be abused for a time but not for long; it is essentially moral. We who are made, or at least are being made, in the image of God, come nearest to His likeness in organizing and doing great things with the aid of other men whose wills we inspire and by means of the materials and forces with which He has filled the world and which we have conquered. The instruments of true organization are hope, not fear; ambition, not despair; love, not indifference. The true master of men appeals to the high motives and aspirations; creates an atmosphere which awakens and inspires; is big, bold, powerful, and attracts and attaches to himself the wills of his men. Forces, things, men, are all the raw material out of which he builds vast structures, using each according to its fitness for his plan, but without violating either the laws of matter or the individuality and freedom of man."

Such sentiments as these which I have quoted put a new meaning into the movement toward organization and combination. These general questions are not separate and apart from the field of the engineer. They are vitally connected with his work and his interests. He who has paved the way by the development of material things for combination in financial and commercial and industrial affairs, which in turn have led to new social problems, has assumed new relationships and new responsibilities. He has

furnished the machinery and the material appliances and facilities on which the great interests of the present are based. May not the methods and the principles and ideals which have proved successful in dealing with material things be applied also to those organizations which deal with men? Has not this material basis of modern life been more successfully and skillfully and completely established than its financial and political and social relationships? It is unjust distribution of wealth and speculation, it is corruption in municipal and general government, it is conflict between laborer and employer that disturb and threaten. The engineer is in contact with facts, he has learned the value of truth. He knows and he respects physical laws. Effects follow causes quickly; failure is the certain consequence of false data or bad methods. But human affairs are more complex, failure cannot be so readily traced to its cause, the truth is not so evident, nor is it so respected, yet after a longer time it is just as surely final. The ideal underlying engineering work is efficiency—the production of the maximum result with the minimum of effort. The prevailing motive elsewhere is selfishness. Trace them back to their ultimate causes and you will find that the real danger in business is that which comes from greed, and the real cause which underlies the conflict between labor and capital is selfishness. The aim of the old-time military engineer was destruction, the object of the modern engineer is construction. Engineering became a new factor in world history when it severed itself from warfare. Who can picture the transformation when the principle of war and of selfishness in business and in social affairs shall be supplanted by higher and nobler and better motives? Then we shall find that the Golden Rule—the law of love—and the law of efficiency are one and the same.

To you who are about to step forth from your Alma Mater there opens a marvelous opportunity. The work of the engineer has deepened and broadened. Not only are the various branches of engineering interrelated and interdependent in new ways, but the successful carrying out of the largest undertakings depends upon the concurrent effort of the engineer, the financier, the captain of industry, and the manager of men. He who can secure

the highest results is he who combines in himself the essential elements of leadership in many fields. Have an eye on the future of the football engineer who stands well in his classes.

I repeat, the underlying material basis of the past century's progress and of present prosperity, of the evolution in commercial and industrial and social conditions, of modern coöperation, is engineering. But not only has engineering work made them possible by giving them a material basis, but the modern corporation should be operated upon engineering methods, and modern society should have as its ideal the engineering principle of efficiency. Economy alone justifies the modern business corporation —every one of them needs engineers to lay the foundations for economy of production or of operation. The future calls for engineering work greater in amount and higher in kind, it calls also for engineering methods and engineering ideals, it calls for men who can build bridges and engines and cities, it calls for men who can direct human as well as physical forces, it calls for men of strong character, inspired by high ideals who can transform modern life by engineering principles as well as by engineering practice and by so doing embody in our commercial and political and social life the simple principles of efficiency.

Several months ago there was a day on which I heard many notable things said by many notable men. It was the inauguration day of your new president. Representatives of trustees and faculty and alumni, representatives from universities and technical schools, the Governor of your state, men from various departments of industrial and commercial and professional life gave expression to various phases of the engineering school and its product. I enjoin upon you that you preserve most carefully the copy of the *Stevens Indicator* which makes record of the addresses on the afternoon and evening of the fifth of February. I heard these addresses and I have read them again. I call your attention to what you may consider a rather remarkable omission. Although there is running through these addresses a consideration of the technical school, of the influence which it should exert upon the young men who are under its care, and although there is specified over and over again the qualifications

which the young men leaving the school should possess, yet there is scarcely an intimation as to the quantity or the quality of knowledge which he should have. But your aim has been to learn the theory and the rules of text-books, to become expert in the shop and laboratory, to pass examinations—it is upon these things that the approval of your instructors and the granting of your diploma has been based, but to these things scarcely a reference has been made by those who in after life express such high appreciation of the technical school and the technical man. I do not think that they discount either scholarship or knowledge, but they do emphasize other things. But it is not a question of what a man has taken in but what he gives out, what having absorbed and digested he knows himself and uses himself for results. It is not a question of the record one may have made in the gymnasium or on the athletic field, but the true value of the physical training is measured by the health and the strength which are available for use in active life.

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I have said that the training of an engineer fits him for other fields. Your own institution, when it sought a business man to strengthen and direct its financial interests, an executive to administer its affairs, an educator to shape its policy, a man to stand as an example before young men, chose wisely when it chose for its president a son of Stevens, one who was by training and by profession an engineer.

ADDRESS TO THE CLASS OF 1904

By

Walter C. Kerr

It is a pleasure to talk to a lot of young men who are about to become engineers. It was not so long ago that I came to your age less well prepared, perhaps, than any of you. When I look back at the engineering education through which men of my time were launched, and then consider the training you have had and the opportunities before you, I have reason to wonder why I am here.

I hesitate to advise you. You have already had so much advice that I do not know whether you can hold more. What I can say in a few minutes will amount to little, so let me use these minutes to suggest that you advise yourselves along certain lines which I will propose by way of point of view. If you look straight you will see straight. You cannot think wrong and act right. Your perspective will be distorted if you haven't the right point of view.

You are leaving a good institution for a good world. Your Alma Mater has built up around you excellent facilities for giving you what you need, and other institutions have likewise cared for their own.

The so-called liberal education has always been highly academic. Trade school engineering has been strictly non-academic. The two have joined hands fortuitously in our modern institutions. The liberal education has become less and the technical more academic, with advantage to both. There is, however, danger of engineering education growing too academic, for several reasons. One is the disposition to include in technical training a liberal education, which of itself is not undesirable. Another is that engineering professors often lean unduly towards academic views and processes, and thus lose touch with the spirit of the engineering world. Greater than either of these is the tendency of all things to move in the line of least resistance, and all learning which depends upon the intellect alone is more easily acquired

than that which depends upon other sources. The proof of this need go no further than to remember that no literature is finer than that written two thousand years ago; no philosophy has fundamentally improved upon that of the ancients; the highest flights of intellect and mathematics were reached during the ages in which the world was observed to be composed of four elements —earth, air, fire and water.

A review of knowledge shows the great preponderance of the intellectual over the material, and it is only within late centuries, in fact, almost the past century, that the human mind has seemed capable of turning from the lesser resistance of intellectual attainment to the greater capacity for physical observation and comprehension. We have but recently come to the era of intense mental operations, dealing with laws and principles which require insight greater than the intellect can grasp unless aided by the senses. Contrary, therefore, to common belief, I assert that the highest refinement of knowledge follows from the highest use of the senses; and that it has taken thousands of years of pure intellectual development to attain a state in which the powers of nature can, through the human intellect, be made useful to mankind, and add largely to knowledge. Do not, therefore, get a wrong view of the faculties involved in science, in the application of the laws of nature, applied mechanics, and the powers of comprehension which underlie engineering. There is still room for doubt —not debatable here—as to what constitutes liberal education.

I hope for the time when the spirit of engineering as found in practice will form a more definite part of engineering education. This, I think, must come through the professor keeping in close practical touch with the engineering world. There are various ways in which this may be accomplished, but I know of none better than by each professor doing a reasonable amount of practical work for commercial purposes. Under some conditions, this may be consistently accomplished during a portion of the time, but I am inclined to think that eventually our professors will devote all their time to instruction while they teach and go periodically into the world, a few years at a time, for practice. Thus the professorial life would not be so exclusively educational, and our

growing engineering institutions would be enabled to enlarge their faculties by the devotion to teaching of a portion of the time of men who are primarily engaged in commercial work.

Now that you have your so-called education, what are you going to do with it? I cannot tell you, but I can suggest some points of view.

Begin by forgetting yourself. All thought of self is some form of selfishness, and selfishness never produced anything better than more selfishness. It often breeds something worse. Genius is all right in its way, but it will not do your work. Get a right idea of work. Remember that time is the essence of most things, and is not inconsistent with thoroughness.

We hear much about opportunities. They are everywhere plentiful. Remember that your opportunity is the little one that lies squarely in front of you, not the large one which you hope to find further along. Many a man is surrounded with opportunities who never seizes one. There are traditions that Adam, William Tell, and Sir Isaac Newton each had an affair with an apple, but with different results.

Your first duty is always to that which lies across your path. The only step which you can take in advance is the next one. This leads to a simplicity of action which is commendable. Don't ramble.

The refinement of thought which is apt to follow high training often leads the mind to overlook simplicity and to even seek complexity. The wealth of modern appliances tends likewise; and it is thus easy to acquire that over-refinement, often termed theoretical, as against the simplicity which is called practical.

From one point of view all graduates can be divided into two classes: those who think their knowledge is a little long for their opportunities; and, those who think most anything is a little long for their knowledge. Both are apt to think that the knowledge they have acquired will become the essence of performance. You will soon find that knowledge hasn't much to do with effectiveness. It is necessary, only as words are essential to the expression of thought. You will find knowledge a good tool, but not the vital force with which you perform. You will fall back upon

human effort and action, and find that it is the human-engine and not the knowledge-engine that does the work.

Cultivate singleness of purpose. This is more important than you may think. It is intuitive with the comparatively ignorant, and often absent in the highly trained. We are frequently surprised at the great competency of the ignorant contractor or foreman, on whom judgment is often passed by saying that he is a practical man and gets results. Analysis will show that his best quality is singleness of purpose, which leads him to vigorously do the one thing before him, without distraction following from knowing or thinking about too many other things. The broadening power of education and training increases the range of contemplation, but unless the power of concentration is cultivated there follows a tendency to scatter instead of to acquire that singleness of purpose which leads to effective action. David Starr Jordan has said:

> "The purpose of knowledge is action. But to refuse action is to secure time for the acquisition of more knowledge. It is written in the very structure of the brain that each impression of the senses must bring with it the impulse to act. To resist this impulse is to destroy it. . . . . This lack of balance between knowledge and achievement is the main element in a form of ineffectiveness which, with various others, has been uncritically called degeneration."

Thus President Jordan shows how even much more than a little knowledge may be a dangerous thing. The highly trained man therefore needs, as a complement to his training, unusual powers of concentration, in order that the virtue of singleness of purpose may not be lost. This faculty a man must have or acquire himself. It is not in the books. It cannot be taught. It can only be suggested by precept and example.

From directness of purpose naturally follows diligence in getting what you go after, and not being easily turned aside by resistance. When you are getting what you go after, get it all. Avoid the mediocrity of compromise. Be thorough and stand for full competency in everything, from main essentials to details. Just so far as education, assisted by concentration, contributes to singleness of purpose it is useful, but where by length, breadth or depth it dilutes human effort, it lacks value. It is, therefore, not

so much the question how much educational training you have as it is how you use it. Some can use a little with great effect, because their point of view is right; others scatter so badly that they cannot use their knowledge at all; while some distorted minds seem to have a faculty for misapplying a large amount of acquired knowledge through complicated processes full of error. To be right, you must be 100 per cent right. Charity may pardon human nature its percentage of delinquency, but this is a human matter. The laws of nature, mathematics, and engineering do not pardon anything. The man may therefore be absolved from censure, but his work must stand the rigid test of inviolable law. Nor is it too much to say that you must be right the first time. Much of our engineering is done only once, and it must be done right that once. A man who has learned by experience to do a thing deserves no credit for doing it right. He is then only a repeating machine. Real power is characterized by ability to perform right the first time that which a man never did before. Such performance involves the power to assimilate and adapt experiences, of more or less like or unlike kind, in a way to bring forth correct results. This is the true use of experience, wherein a man is a thinking, active power, and not a mere repeater.

Clearness of thought is an essential often lacking. This, too, follows from concentration and singleness of purpose. Many minds confuse themselves with a wealth of ideas, grading from the well-formed to hazy, indistinct conceptions. You can clear your mind by proper habits of thought. Train yourself to separate essentials and non-essentials and confine your consideration to the essentials; to distinguish between what you know and what you only vaguely surmise, clearly eliminating opinion from facts. Nothing is more helpful than conference with yourself, in which you determine what you think of your own thoughts. This is aided by the moderate cultivation of system—thinking in an orderly manner, beginning at the beginning, ending at the end, and being sure to have a middle. With this there should be no slavery to system, but let each find his own logical way.

Besides what are commonly known as ideas, men have intuitions—sometimes called impressions or opinions—which they

cannot readily prove. These I believe are identical with reason, except that while reason is composed of a sequence of distinct ideas, each capable of expression, intuitions follow from the capacity of the human mind to integrate small ideas and impressions, each of which is too small to stand alone, or to be readily expressed, but which integrated form a concrete mental impression, called an intuition, and which is of exactly the same character as reason, except that it is composed of smaller and almost intangible units. Do not, therefore, discard intuitions as inferior to reason. Analysis will sometimes develop intuition into an expressible logical thought.

You have all had ideas and you will have more of them. Some ideas seem bigger than others. These mental forces, like other forces, only do work when in motion. Hence your ideas are only valuable when put into execution, *and this often requires more talent than to originate them.* Some men seem to consider their ideas so good that they will execute themselves.

A point of view is involved in the power to rationalize. This again is a thing which each man does for himself in his own best way, and its essence consists in asking one's self whether the thing is reasonable. It is a great check upon error. It applies equally to nearly everything of which engineering is composed. It is the power of the human mind, after performing in more or less systematic and conventional ways, to stand off and look at results and ask one's self whether they are reasonable. One man will figure that certain material weighs two hundred tons, and believe it. Another will say that there is something wrong in that, for it all came on two cars.

Every young man comes sooner or later upon a dilemma, in which he is more or less drawn in opposite directions by his confidence on the one hand and timidity on the other; a desire to perform backed by the courage of his convictions, but on the other hand resisted by his inability to see his way through in orderly progression to a desired end. This is about the time to show your nerve. Don't be dazed and baffled, but make a start. Use your wits and you will get somewhere, and if you cannot always see the end it will constantly get nearer and

plainer when you go as far as you can see and then see how far you can go.

Another point of view concerns engineering expression. This may be through designs, drawings, mathematical determinations, or words, and finally by work done. The lamest of these is words. All engineering is so non-literary in character that the use of language is too much neglected, leading to expressions that do not properly convey thought. In engineering, it is not rhetoric but diction that makes expression clear, and diction is best learned from the dictionary. It is well for a young engineer to cultivate his vocabulary, and learn to use words in their right sense. They are then usually understood, even by those who have less knowledge. A word of caution, however, against assuming that a lack of facility of expression can cloak an absence of knowing what you think. Engineering documents, specifications and letters are full of misstatements due to the careless use of language. Conciseness cannot be overestimated. Brevity is desirable, but not at the expense of clearness. Conversely, a certain degree of facility should be acquired in reading the words of others. Some seem incapable of understanding plain language when spoken or written. Anyone persistently failing to understand the language of others has limitations needing correction.

One of the worst attributes in engineering, and which is fundamentally born of conceit, tends to fasten error, censure and responsibility on others. There are times when a man needs to stand himself up in front of himself and ask: What is the matter with me? The capacity of any man to admit his own error and frailty of judgment is a measure of strength rather than weakness.

Perhaps no personal attributes are of greater importance in the conduct of the business affairs of an engineering life than good cheer and non-contentiousness. Not only because these are right and agreeable, but because they enable a man to work better, to be better understood, and they add weight to his opinions. There is a certain reasonable optimism of manner which makes a man and his ideas welcome, even though they must of

necessity sometimes be critical. To vote aye and believe that things can be done makes a man helpful to others and to enterprises. Discontent is not a sign of progression.

Each of you probably has a preconceived notion of following some line of engineering. Be careful about your self-analysis. The field is large and has room for all of the various types of men, some of whom incline to constructive operations, others toward inventive, some to the contemplative. Again, within all these divisions, some tend towards professional and others trade work. No one can advise what is best for you. This you must find out for yourself. I cannot help, however, a certain predilection in favor of a young man being just an engineer, and not any particular kind of an engineer—not specializing while too young, but developing along versatile lines, ready to turn his hand equally well to any task within his general scope. In this, there is a good deal in the point of view, and the man who believes he can apply himself in one direction about as well as another will come nearer doing it than one who thinks he cannot.

When you start your practical work, you will doubtless try to improve things. That is a legitimate purpose, if not overworked. I am not going to attempt to tell you what needs improvement, but the one improvement that most things need is in the line of sufficiency. You can think this over for yourself and apply it where it fits.

There is another point of view seldom considered. It relates to environment and the power to vary. It is pertinent to engineering. Man ascended through and exists under the laws of an organic evolution, which occurred almost entirely in early geological ages, under water, within a few miles of shore, under substantially constant temperature, constant pressure, and uniform food supply, and thus in about the simplest possible environment. It was caused, primarily, through the force known as the power to vary, and the reason that evolution spanned the space from the simple cell to the vetebrate animal in so short a time was that this power was not resisted by complex environment. When organisms emerged from the water to the more complex environment of the land, and as environment grew con-

stantly more intricate, its resistance retarded evolution and resulted in fixation of species until ordinal evolution practically ceased. It is the complexity of the environment of the world that presses upon you and tries to hold you back from the exercise of your native power to vary. A good environment is certainly less harmfully resistant that a bad one, but remember that environment is not a force. It is not a producer. You are the producer. Whatever be your power to vary, environment will only resist and reduce it.

Therefore, remember that all the good you accomplish is going to come out of yourself. You cannot borrow it and you cannot make it out of that which has been poured into you by education or otherwise. All that you receive is only a certain quantity of knowledge, acquired by education, experience, or other training, which will have a certain influence upon what comes out of yourself as your own. It is the inherent capacity to perform with your own brain which will make you what you become, and not the mere transmission of that which you have acquired. Your knowledge, therefore, is of little avail until you make it inherently a part of yourself through mental assimilation and utilization. The clearer you comprehend these things, the more readily you can make use of them as against the process of mere acquirement with a vague notion that in some way or other what you acquire may be of benefit, or that environment will be the force that makes your talent effective. Some have gone through experience without acquiring it, and many a man who has received an education has not got any because he allowed it to be a thing apart from his personality and it slipped away.

ADDRESS TO THE CLASS OF 1905

By

Palmer C. Ricketts

To you, gentlemen of the Class of 1905, there is nothing stale or hackneyed in this moment. Many of you have been looking forward to it for years—certainly for the past four years. To most of you it means the end of your school life and the beginning of your life's work as engineers. It means to you victory also: the successful completion of a long and arduous course of study, of a course in engineering second to none in the land, the winning of a struggle requiring brains, energy and persistence, a struggle in which many looking forward to this day as their goal have fallen by the wayside, while you have been successful. You, then, are picked men standing upon the threshold of the future looking forward to a life of happiness and work. The rosy dreams of youth encircle you. The confidence of youth is yours. This is well.

Have you ever stopped to think how fortunate you are, you who sit here to-day buckling on your armor? What a priceless armor you have to wear! How few, how very, very few among the vast army struggling to-day toward the goal you seek—whether it be fame or honor or riches—have the weapons you have with which to do battle! If never before, stop now—before you turn your faces for the struggle—and cast one backward glance of thankfulness to those without whose aid you would have been to-day only soldiers in the ranks, to your teachers who have worked faithfully to prepare you, but above all to your parents, who, through many years of love and care and self-sacrifice, have labored to give you advantages which perhaps they never had, so that you might be better fitted to meet the difficulties of life. They may feel themselves well repaid as they sit here to-day proud of your success. But you must not forget the part due to them.

Do not think that your education is completed. Do not make up your mind that you are through with your studies and that hereafter you will have to do only with practical work. You have completed only one period of your education, and if you wish to become professional men in the highest sense of the term, you must resolve to continue not only your practical work, but your theoretical education as well. I am aware that this is difficult and that after working long hours during the day, you will find it hard to turn your mind to the more abstruse questions of theory, but you will make a great mistake if you do not do so. Knowledge is very rapidly increasing every day in all branches of engineering by an accelerated growth, and if you are to be successful in any specialties you must keep abreast of the advance continually being made in the direction in which you are more particularly interested. Your engineering education up to this time has been quite a general one. It will be well in the end, I believe, if circumstances permit you to spend several years of your early professional life in securing experience in different branches before determining upon the specialty or specialties you will finally pursue. The field is so broad and so quickly broadening that you must come to a specialty in the end or work in branches closely allied. The division lines between the branches, however, are not distinct. Not only do the fundamental theoretical principles of mechanics apply to all branches alike, but no one can confine himself to one branch of professional work without being familiar with practical applications common to others. For instance: in order to become, in the highest sense, a specialist in the design of the superstructure of bridges a man must have considerable knowledge of machinery as well as of hydraulic and metallurgical engineering. Certainly he must have more than a general knowledge of these subjects.

You cannot, of course, absorb all the new material published, but you should study the more important new books in your specialties and read the more important articles in some of the principal technical periodicals. You should also join one or more of the leading engineering societies and should become familiar with their transactions. You should try to make the acquaintance

of older members of the profession. You will obviously gain information by such association. Many of them will not hesitate to give you the benefit of their knowledge when you need it. And the wider your professional acquaintance the better it will be for you in many ways.

In spite of your preparation and education, remember that you are ignorant. It is true that your technical training has given you great advantages, but remember that you really know very little—little not only of the vast store of knowledge outside of your profession, but even of the practical side of your profession itself. Many a workman, ignorant from your point of view, can give you professional information of great value and of which you are absolutely ignorant. It will be well for you to remember this. You will be wise and grow wiser if you learn to watch closely how skilled workmen do their work, and if you are not too proud to question them when necessary. Above all, do not show pride in your knowledge, nor contempt for ignorance. A most valuable sentence to be remembered, certainly by a teacher and I believe by any one who has to deal with minds less mature than his own, is the remark made by one great Englishman of another:

"He had none of that contempt for human ignorance which is itself one of the most provoking forms of ignorance."

You will have learned a valuable lesson in the handling of men when you thoroughly learn this sentence and thoroughly understand what it means. Be patient with those of less intellectual quickness than yourself. I well remember the experience of a brilliant man—a technical graduate—who, without having passed through the various subordinate grades, had become the president of a certain large manufacturing company. He never could understand why he could not get along with the men. An observing friend of his told me why. He would pass through the works asking questions, and before a foreman or workman had half completed his answer, his quick mind had grasped it and he had passed on leaving the man agape and confused. If he had been more patient, with more tact, he would have been more successful as a manager. He would probably have been more

patient if he had begun in a subordinate position and had been compelled to work his way upward. Very rapid advancement is one of the most unfortunate things that can happen to a young engineer. Some of you may not think so from your present point of view. Later you will find this to be true. Nothing will so well fit you for the responsibilities of a high position as drudgery in the successive lower positions leading to it. In no other way can you master details essential to your success in places of responsibility.

In professional life it is not necessary for a man to tell all he does not know. In my teaching when I begin with a new class I pick out first those students who do not answer decidedly, who are in the habit of qualifying their replies, who "think so" or "guess so" or who put, in their voices, an interrogation point after their answers. I tell them they must change all this and show them the kind of impression they would make on a client if they "thought" or "guessed" when he came to them for professional advice.

In your future work if you wait to do only those things which you have done before, you will never become leaders in your profession. Do not be afraid to take responsibility. You will develop all the more rapidly as responsibility is thrust upon you. It is necessary many times for an engineer, in the course of his practice, to take up work which he knows he could not do if it were to be done immediately but which he knows he will be thoroughly prepared to do when the time comes. Remember that work goes slowly, that difficulties come singly, that there will be time for reflection and that in this time you will be able to collect your ideas and study special points. One of the greatest advantages of an education like yours—I had almost said the greatest —is the confidence it tends to give you in your own powers. You know where and how to look for information you may have forgotten, and where you will be most likely to find knowledge of which you may be in search. In your engineering course you have doubtless been taught many things not because they were themselves practically valuable but because they showed you the limitations of methods used in practical design. The "rule of

thumb" man without a theoretical education may know how to use certain equations or rules, but he knows neither how they were originated nor the limitations of their use. The fact that you do is bound to give you confidence in your capacity to do work. Learn to exercise this confidence. I once heard a graduate of a school of engineering, who had become the president of one of our great railroads, tell of his first day of practical work. Shortly after he was graduated he was sent out at the head of a party of surveyors and told to do a certain piece of work. He found that he could not do it, but he knew that it was not beyond him if he were able to find time to consult his books and to reflect, so he said nothing but started his party on some work which was not relevant but which kept the men busy all day. That night he worked hard and the next day he was ready for all contingencies. His party never knew the difference.

As you sit here to-day with one period of your life about to close and another with all its unknown possibilities about to begin, some of you are likely to look forward with uncertainty and perhaps with some dread into the immediate future. You may have heard that the professions are crowded; that every place is filled, and you may fear that there is small chance for a young man to obtain a good position at the beginning—that there will be much drudgery with little hope of promotion. What chance have I, you may think, in entering a profession where I will have to compete at the outset with men of perhaps equal training and of long experience? What chance to succeed where such a crowd of able men are all struggling for the same end? What chance to improve devices which so many great minds have dwelt upon, or methods developed by many years of study? If you have placed your hopes too high, if you have overrated your present value, if you expect to rise too fast, you will be disappointed. But it is an undoubted fact that there is to-day plenty of work and at good pay in all the professions in this country for young men of ability and energy, for young men not afraid to work. And this is particularly so in the profession of engineering. Never before has there been such a demand for capable engineers. The country has never been as wealthy, the

compensation for professional services has never been as high and never have the prospects for the future of our profession been as bright. And you, the educated young graduates of to-day, enjoy another advantage not possessed by those who sat in your places ten or even five years ago. Although your number is increasing each year, the value of your services is becoming more and more appreciated. Managers who ten years ago would have given you scant attention, if you had applied to them for work, are now perforce seeking you. The number of employers imbued with the idea that a so-called "theoretical education" rather lessens than increases the value of a young man for the practice of the profession of engineering, and who place their dependence upon the "practical man"—meaning the man without a theoretical training in the schools—is very rapidly becoming smaller—I believe has almost disappeared. This source of competition has been almost eliminated and your chances of making a satisfactory beginning have been correspondingly increased. You will note that I have said a beginning. Do not, however, overrate the value of your education. As you go forward you will find that you will often have to compete with men of great energy and capacity who have forged ahead in spite of a lack of the educational advantages which you have enjoyed.

When you have secured a position your chance of advancement depends upon circumstances as well as upon your own efforts. Vacancies are continually occurring. Promotions are constantly taking place. It is to be regretted that the latter do not always depend upon merit. You may become certain, after you have been employed a sufficient length of time to thoroughly understand the conditions, that adventitious reasons and not merit will determine advancement in that particular corporation or business. In that case the length of time you stay should depend upon the value to you of the knowledge you are acquiring. Do not, however, make up your mind too quickly that your chances are small. Whilst favoritism is often shown, employers are generally forced to rely on men who have shown themselves hard-working, conscientious and capable.

If you are employed by a large corporation do not get the idea

that the higher officers know nothing of you and that zeal and efficiency will not increase the chances of your promotion. You will make a great mistake if you imagine that earnest and faithful work will not count and will not be known. The men in command know much more than you may think of the records and capacities of those upon whom they have to depend for their own success. The success of the manager depends largely upon the efficiency of those whom he employs in positions of trust, and the best managers well understand that one of their most important functions is to obtain an accurate knowledge of the capabilities of the men in their employ. Work hard and wait. Make the best of the small opportunities which come to you so that when the large ones come you will be well prepared to grasp them. Remember that opportunities seldom come to those who fail to seek them. As has been said, opportunities are the worst pitfalls for the unprepared, but are the ladders of success for the patient toiler and the ever ready mind.

You may have noticed how often I have used the word work in speaking of your chances of usefulness and success. It hardly seems necessary for me to dwell upon the importance to you of constant and earnest labor. By no means the least valuable part of your education here is the capacity for work you have acquired. Probably many of you have learned here, for the first time, the importance of steady application. It is well for each one of you if this lesson has been thoroughly impressed. The biographers of great men give many reasons for their success. But on each list one reason invariably appears, so invariably as to cause the origination of that hackneyed definition of genius which perhaps is the one, in the main, most nearly correct. Not alone in the more prosaic of the occupations of men has the capacity to take pains counted as the greatest of the factors which tend to differentiate its possessor from the common throng. But the greatest of sculptors, painters and musicians, men above all others with whose names we have learned to associate the word genius, would never have earned their fame if they had not possessed this capacity developed to an abnormal degree. Each one of you in the future will attain his measure of success. Many

complex causes, some beyond your help, will affect this. But of one thing you may be certain; that whatever other qualities which make for success you may have, if you do not work earnestly and faithfully, your chances will be small. And on the other hand, whatever qualities you may lack, if you are persistent and work constantly, you will be certain to be reasonably successful in that which you undertake.

Although work is a potent factor affecting your careers, it does not follow that you must make drudges of yourselves in order to succeed. Men, like children, are made dull by no play. There is plenty of time for recreation. If you really love your profession you will find your best and highest recreation in your daily work. But in order to do this work in the best manner you must have interests beside it. You will make all the better engineers if you broaden your horizon in directions apparently alien to your work. In music or literature or art you may find those broadening influences which increase your general knowledge and thus directly affect your capacity in your own specialty.

I cannot omit mentioning one factor of the greatest importance in your professional life. From the day you begin your career to the day you end it your integrity should be beyond question. It would be futile for me to say to you that you cannot be successful unless you are honest if the term success be used with a meaning often given it. But even with this meaning your chances are very much greater if your integrity is unquestioned. Leaving out of consideration all the higher and better reasons and assuming that the nobler instincts are wanting, it still pays to be honest. Integrity is a commodity of the highest commercial value. In no profession is this more true than in ours. It is not enough that the young engineer should be honest. He must be extremely careful in dealing with contractors so that no unscrupulous person can take advantage of his inexperience to make use of him and injure his reputation.

Gentlemen of the Class of 1905, you are fortunate in the choice of your profession. If you wish to do good in the world, if you wish to add your mite to the cause of human progress, if you wish to increase the total of human happiness, you could, I

believe, have chosen no other profession to accomplish your object so well. Think what the engineer has done for the world in the short span of a human life, in threescore years and ten. Beside those of the other professions the history of ours is short. But how full of incident and progress! How startling the rapidity with which great events and discoveries have succeeded each other! How enormous the value of the work of the engineer in the development of the world's resources! Stop for a moment and think of the condition of our country before the first locomotive was built, before the first rail was laid! What harbingers of progress those metal bands have been! As they have been pushed forward and outward, civilization has followed them. Populations have been enormously increased. Barren wastes have been converted into abodes of happiness and peace. And on the seas great steamships, by increasing facilities for travel and by the transportation of the varied products of the earth, have widened the horizon of nations and broken down many barriers to progress. But this increase in the facilities for travel has been only one of the many benefits resulting from the work of the engineer. To him are due as well great constructions which in many lands have added to the knowledge and health and happiness of many people: great dams which store water for irrigation and for the production of power, machines for the transformation of energy and the transmission of power, whose intricacies and whose magnitude are marvelous tributes to genius, sanitary constructions and systems which have enormously diminished the ravages of disease and have added to the length of human life. You, young gentlemen, are about to enter this noble profession. You are to take up the work now dropping from the hands of many who have been faithful servants to the race. Try to be worthy successors to them. Emulate not only their work but their integrity and their truth. Do your duty. Make the most of the talents which have been given you. Most earnestly I hope that each one of you may have a life full of usefulness and happiness.

ADDRESS TO THE CLASS OF 1906

By

John Hays Hammond

This is the era of the engineer. To her supremacy in the industrial art, rather than to the triumphs of diplomacy and of war, America owes her recognized position in the forerank of the nations of the world. Therefore it is not an idle boast to claim for the engineering profession a large, if not indeed the chief part in this attainment. Not only in the development of new spheres of activity, but among the pioneers of civilization itself, the engineer has been ever in the van. First, as the mining engineer in quest of gold, and then followed his *confrères,* the civil, the mechanical and the electrical engineers in turn.

Conspicuous in this work are the sons of your honored Alma Mater. The names of Brinkerhoff, Gibbs, Glasgow, Jacobus, Kelley, Lieb, Wolf, your learned president and many others, come to one's mind in this connection. Therefore you, gentlemen of the graduating class, are to be specially congratulated upon the propitious circumstance that you enter upon a career in a profession to-day honored throughout the world, and that you go forth to seize the opportunities offered you and to assume your responsibilities accredited graduates of the Stevens Institute of Technology. It is with reference to your opportunities, that is, the province of your profession and also of the duties imposed upon you individually and collectively by your Alma Mater, that I shall speak to you.

Though, as I have said, the engineering profession has done much to promote the welfare of mankind, there has been, I think, a wholly inadequate appreciation of its services.

I do not wish to lay myself open to the imputation of commercialism by intimating that success can be best reckoned in dollars and cents. But nevertheless, I do confess my conviction that money is an important consideration in the measure of accomplishment. I hasten to disclaim, however, any intention to

disparage the admirable work done by engineers sometimes in a position where the guerdon lies not in the *pecuniary* recompense, but in the winning of fame, which is indeed more precious than any other testimonial of success. Notwithstanding this reservation, I believe that we owe it to our profession to insist upon a fair monetary compensation for our service as engineers.

In common with that of the wage-earner, the remuneration of the engineer is determined largely by the law of supply and demand. Until within the past few years, there has been a superabundance of engineers, and the shrewd business man has not been slow to take advantage of the situation to cut down salaries and fees. To prevent the recurrence of this condition and the consequent professional congestion—if I may use the term—I advocate the extension of the *scope* of the engineer. I would have him invade the sphere now monopolized by the employer and the capitalist and eventually become, in fact, himself, the master, for I cannot see wherein a technical education *per se* should deprive a man of business aptitude.

Contrariwise it is not unreasonable to believe that a man equipped with technical education supplemented by experience, and a knowledge of business methods, is far better able to promote and to manage industrial enterprises than the so-called practical man of business. A business man who has the requisite technical knowledge to become his own engineer has as great an advantage over the non-technical business man as has one speaking a certain foreign language over his less fortunate competitor, who must obtain the services of an interpreter in the conduct of negotiations in that tongue.

In other words, where the engineer himself has the direction of the financial, the commercial, and the technical departments of an industrial enterprise, there is a prevention of what I might call the lost-motion that obtains under the present system.

Following the procedure indicated, not only would there be greater opportunities for the engineer, but there would also be introduced into the financial management of industrial enterprises, a conservatism and an honesty of purpose which unfortunately does not always now obtain.

This suggestion may seem somewhat visionary to those who have followed the conventional lines of the past; but having observed the success that has rewarded the efforts of the mining engineer in this direction, I am emphatic in advocating the extension of the principle to all branches of engineering.

Until recently the mining engineer has also submissively borne the employer's yoke and accepted whatever compensation was vouchsafed to him by the not always liberally disposed capitalist. Latterly a new era has dawned.

The mining engineer has at last struck for more equitable treatment, and as a result is now able to look forward to becoming eventually a partner, rather than to continuing indefinitely as an employee in the enterprise under his direction.

This he expects to accomplish by serving at first his apprenticeship strictly in the position of an engineer, and by subsequently rendering his professional services for an interest in the profits of the business.

Obviously all engineers do not possess the qualifications requisite for commercial success. But they will not, I believe, be found more generally lacking in these essentials than is the average man of affairs. You quite naturally might ask how this plan meets the views of the employer. Does he regard it as antagonistic to his interests and to be resisted by him? Having in mind the experience of the mining engineer, I answer decidedly not, but on the contrary that the plan is one which strongly commends itself to the employer, for the reason that such a business arrangement not only assures the loyal coöperation of the engineer, but secures his undivided and constant endeavors in furtherance of what thus becomes the mutual interest of the employer and engineer. This phase of your professional opportunity is in my judgment of paramount importance, and I commend its favorable consideration to those to-day embarking on their career. *Verbum sap.*

The question is often asked, What are the essentials of professional success, and should not a special aptitude in mathematics, mechanics or other branches insure a successful career? To this question I have always replied, that while those

who have exceptional ability in the mastery of the studies of the curriculum are greatly favored, and while further, a technical education is in itself indispensable, I would nevertheless rate these qualifications far lower in the scale of relative importance than the *individual character of the engineer.*

First, then, and above all other considerations, I would place the possession of character. An honest, clean-cut, straightforward, conscientious young fellow, ambitious, persevering and last, but by no means least, level-headed would in my judgment, possess 75 per cent of the essentials of success; while in relative importance I would not attach more than 25 per cent to the possession of a technical education. And I say this without in any degree depreciating the inestimable value of a technical education.

Without character the monument of the engineer would be as unstable as an edifice where the mortar is deficient in lime. Therefore I urge you to persevere in the development of character in its widest sense, and especially ever to be jealous of your reputation for integrity.

> Where ye feel your honor grip
> Let that aye be your border.

There are two critical epochs in a man's career. First, when he graduates and starts on his life's work. A *start* in the right direction is all-important. The Germans have a proverb illustrative of this:

> Gut begonnen:
> Halb gewonnen.

One of the greatest enemies of success, as you have been told times innumerable (but this fact shall not deter me from repeating it) is *conceit*—that kind of conceit which manifests itself in what is aptly, if not elegantly, called "the big head." It is not the dolichocephalous nor the brachycephalous kind referred to by phrenologists, for in spite of the paradox, it comes rather under the category of the "pinhead." Whatever the shape may be, a small quantity and inferior quality of brain matter is characteristic of the disease.

There are many "big heads" graduated from college every year, but when the disease is not eradicated or checked, the victims are soon "sized up" by the discriminating public and forthwith relegated to the category of mediocrity and thenceforth are but laggards soon lost sight of in the race of life.

The disease is sometimes also latent and does not develop in a dangerous, nor even to an obnoxious, degree until later in life—usually at the time of some transient success, commonly of the financial kind, whereupon it often develops with extraordinary rapidity. This is the *second critical epoch.*

It was the inimitable Touchstone who said: "Call me not fool till heaven has sent me fortune."

The "big head" that has attained this temporary or more likely merely fancied success has reached the highest point of his self-conceded glory and, like Lucifer, falls, never to rise again. For the rest of mankind it is a very fortunate effacement.

This disease is fortunately rare among the graduates of scientific schools, for there the subjects taught provide in themselves correctives of conceit.

You may rely upon it that the *demeanor* of the successful man is the absolute index of his mind and character. The really great man who achieves genuine success is of all men the most modest as to his accomplishment. He has, of course, which is proper and desirable, a self-respect, and also pride in his achievements, but he is not the least conscious that his success has been due to any greatness on his part, ascribing it rather to that kind of genius that is synonymous with honesty of purpose and indefatigable endeavor.

The truly great man knows how insignificant are his achievements compared with the work before him, and would say, as did Cecil Rhodes on his death-bed—a truly great man and one of the most modest whom I have known—"So little done, so much to do."

After safely escaping the crises referred to, keep on raising the monument of your success. The higher the monument the broader must be the base, for you will find it indispensable as you are brought in contact with men of greater importance in

your day's work to possess a wide knowledge of many subjects that cannot be included in the curriculum of the technical schools.

You should, therefore, complement your technical education by a study of the humanities, since you shall find the possession of a capacious rather than a subtle mind to be of incomparable advantage.

Finally, if you have "taken the current when it serves you," you will obtain that success which will not only prove a gratification to yourself, but a source of pride to your ever solicitous Alma Mater. But should untoward circumstances intervene to frustrate your endeavors, you will at least find solace in the reflection, " 'Tis not in mortals to command success, but we'll do more, Sempronius, we'll deserve it"—or perhaps expressed in the sententious, if uncouth, language of the cowboy, "Life ain't in holding a good hand, but in playing a *poor* hand well."

Now as to your duties: You have obligations not only to your profession, but to the community in which you live. Fortunately for yourselves and your fellow men, you do not belong to that pitiable and yet despicable class of idle rich that are born to lead a life of indolent contentment, an existence worse than negative, inasmuch as its example is enervating and demoralizing.

Our condemnation of idleness must not involve our approbation of that spirit of hyperstrenuousness that has obsessed not only our days of toil but our hours of recreation as well. But that is another story.

To you, gentlemen of the graduating class, is to-day confided a trust as sacred to her as life itself—the good name and prestige of your Alma Mater. She looks to you not only to use your best endeavors to bring to her renown through your professional accomplishments, but she relies upon you also to represent her faithfully in the discharge of your duties as patriotic citizens of our country.

We professional men are so much occupied with our technical work that we are inclined to neglect the political and social affairs of the community in which we live, as well as the larger political and social problems of our country. Were we not actuated by higher motives, our own self-interests at least should impel us to

concern ourselves with these matters, since upon the well-being of the body politic, and the welfare of the country in general, depends the status of our own vocation.

As engineers, individually and collectively, we should set a high moral standard, not only in our professional ethics, but in our civic relations as well. Moreover, we should not be satisfied with the mere example of negative honesty in our lives, but we should be *aggressive* against all forms of corruption, especially, of course, in our own professional field, where our *confrères* should be held strictly to account for all transactions that tend to discredit our profession. For we must constantly keep in mind the fact that it is our profession, and that the encomiums we receive because of our labors are valuable only so long as the profession itself is exalted in the esteem of our fellow men. Therefore keep its reputation unsullied while doing your utmost to magnify its importance.

Although there are, of course, some black sheep even within our engineering fold, there is, nevertheless, among scientific men generally, an unquestionable predilection for rectitude to an extent that is indeed *sui generis*. This is due to the many years spent by them in scientific research, which inculcates a veritable zeal for truth, even to the degree of what Huxley calls a "fanaticism for veracity."

While we must be exacting, as I have said, in our demand for high-grade professional morality, we must not forget that it is *also* our duty to encourage and to sustain those who are striving to win new laurels for our profession.

The unintelligent, unjust and sometimes indeed dishonest criticism of the work being done on the Panama Canal comes to my mind in this connection.

We engineers can sympathize with our *confrères* who, despite the importunate demands for greater haste, insist upon a thorough study of the problems presented before beginning operations which otherwise might jeopard the ultimate success of this the greatest engineering work yet attempted by man.

There is a deplorable prevalence in these times of a class in the community to whom President Roosevelt referred as "muck

rakers." These men constantly scoff at public virtue and feel an ill-concealed gratification in the discovery of scandals affecting men of prominence, especially in governmental positions.

These degenerates should be treated as social abominations, for they are closely allied to the dangerous class of anarchists and nihilists, who are allowed to breed and to hatch nefarious plots with perfect impunity within the borders of our unwisely tolerant country.

My young *confrères,* let us rather incline to idealism and to become hero-worshipers than to yield to the tendency to be hypercritical, or to run the risk of being tainted with "muckrakism." It is so much easier to criticise and to point out the defects than it is to conceive and to elaborate undertakings of importance. As Bacon says:

"There are no reports more readily believed than those that disparage genius and soothe the envy of conscious mediocrity."

Reform is now the popular theme of our statesmen, and the ban of public opinion is fortunately emphatically against dishonest methods in business as well as in public life.

We should, of course, give our hearty support to these measures of reform, but let us do it deliberately, moderately and persistently, rather than by hysterical, paroxysmal and short-lived efforts.

With this final admonition, I leave you:

> This above all: To thine own self be true,
> And it must follow, as the night the day,
> Thou canst not then be false to any man.

ADDRESS TO THE CLASS OF 1907

By

Paul Morton

I consider it a great privilege to be permitted to address the graduating class of Stevens Institute of Technology to-day, and at the outset wish to pay a tribute to the family of celebrated engineers who did so much for the world in establishing this school, the graduates of which are now doing and will hereafter do so much for the good of mankind.

It was my good fortune to have been brought up as a boy on the frontier in Nebraska on the west bank of the Missouri River. My earliest recollection of transportation is of Missouri River steamboats and large trains of covered wagons, commonly called "prairie schooners," passing my father's farm drawn by six-mule or twelve-ox teams and headed for Denver, Salt Lake City or "Pike's Peak or Bust." We were then three hundred miles from the nearest railroad.

With my own eyes I have seen the Indian, the buffalo, the ox team, the mule team, the six-horse stage and the side-wheel steamboat disappear, and substituted in their place I have seen civilization with its railroads, its schools and churches and industries, until to-day there are over 10,000 miles of railroad within a radius of 100 miles from that same spot, and nowhere on earth will one find a more prosperous or more contented community. The last half century has shown more radical improvement in transportation than all the centuries preceding it. Seventy years ago a day's journey was less than fifty miles, now that distance is covered in an hour.

Under these circumstances, it is not at all surprising that I consider it not only a great privilege, but a high honor to appear to-day before the graduating class of the institute founded by the pioneers in solving the problem of steam transportation, one of whom invented the "Tee Rail," as well as the tie and spike construction so generally used throughout the world. What a great benefit it has been to humanity!

Those frontier freighters who crossed the plains were a brave and a rugged set of men and had many difficulties to contend with. There was either too much dust or too much mud, too little wood or too little water, too many Indians or too many buffaloes, or something wrong all the time, although they did have the compensating offset of not having any drastic state regulation, two-cent fare laws, yellow journalism, or any unfair walking delegates of labor to cope with.

We are, however, always confronted with conditions of some kind to overcome, and it is a wise man who adjusts himself to them and undertakes to surmount all obstacles. Complex conditions produce emergencies, and emergencies are met by men of skill and courage.

The young man who starts out to win his way in the world with a technical education has about the same advantage over a competitor without an education that a locomotive possesses over an ox team. Everything is in its favor to start with, but none of you must ever forget that a locomotive can be wrecked in many ways, and with bad handling may not get to its destination with as much satisfaction as the ox team. Much depends upon the road, but more upon the driver. Every man is his own engineer when it comes to selecting the road he will travel through life. If he gets off the track, generally he will be responsible for it and if he is on time he will get the credit.

A young man just leaving college has much to learn. One of the very first things he discovers is that the race for success of every kind is a free-for-all and that in the scramble for place nobody gets much preference. The one person who is to help you most in the great contest is yourself. Self-reliance must be practiced always.

There is no well-defined recipe for success. The chief ingredients of success are hard work and common sense; intelligent industry, in my opinion, is the basis of most of the great successes of the world. Enlightened and willing application to whatever you undertake wins—I mean by this in order to succeed you must have an enthusiastic interest in what you are doing, being fond of your calling whatever it may be and working at it hard.

Few men win in occupations uncongenial to them. My advice is to take up some kind of employment in which you can become absorbed. Get an occupation, if possible, that will entertain you. If you are a mining engineer, make up your mind to be a famous one. Do not be satisfied to be an average one. There is much less competition and much more compensation at the top of any profession than there is at the bottom or half way up the line.

Men in the mining or mechanical profession who can make themselves famous by real merit, who possess good judgment, and are willing to work, never are at a loss for clients.

I consider there is a wonderful opportunity for mechanical minds in the railroad business, and I do not hesitate to say that there is a great demand to-day for first-class master mechanics all over the United States. It is my opinion that one of the weakest spots in our transportation business in this country to-day is mediocrity in the management of the machinery departments of railroads. There are too many engine failures owing to the failure to have the right men in charge of machine shops. Promotions to higher positions in the railroad world are just as likely through the mechanical department as any other. There is no royal road to promotion. Railroad managers are made from all branches of the service, and to have a technical education is a fine basis to work from.

A young man who wants to make headway in the world must have more than a technical education. He must do the small things well. He must not be afraid to work overtime. He must be civil; he must give and take in dealing with his fellow men. Be tolerant of others. The greatest study in life is men. Make it a rule to get along with people. If you know more than they do, let them discover it, you do not have to tell them. It is poor policy for you to assert or even admit your knowledge is the superior. Generally you can supplement your technical education greatly by coming in contact with thoroughly practical men. You must be loyal. Fidelity is one of the noblest traits of man and whatever interest you serve, make it a rule to be faithful to it. When you cannot be loyal to your employer, better find another.

Do not be too independent—I have known some of the very best of men to spoil their careers by the exhibition of a foolish independence. I do not for a minute recommend any man to put up with indignities or to suffer from tyranny, but I do urge every man to learn to control himself, and if for a while your independence seems menaced, bear in mind that many a good man has swallowed his pride and in time greatly profited by his self-control. Self-control is necessary to success. It is not an unusual occurrence for a young man with a technical education to find himself subordinate to a practical, hard-headed, self-made man who from mere envy may at times be unfair. In a case of that kind keep a cool head, and if you deserve it, time will bring things around to about where they ought to be. Self-interest prompts every employer to keep the best men, the ones who can achieve the best results. You must be more than technical. You must be analytical and commercial. You must be posted on shop costs. You may build ever so good a machine, but if its cost is too great, it is of no commercial value.

Material success in this world is largely measured by management. President Roosevelt in talking to me one day on this very subject, gave the best illustration of what management means to an institution, that I have ever heard.

He said as a boy he used to pass regularly by the great store of A. T. Stewart, who at that time was the most successful merchant in the world. Stewart was a manager. He catered to his customers. He studied their wants and personally saw they were well taken care of. He selected his employees with great judgment. He died, left a great fortune, and was succeeded by Hilton, Hughes & Co. The location was the same, the goods handled were similar, the crowds passing along the streets were the same, each year larger in size, but the trade commenced to dwindle. The goods were not shown in an attractive way. The business did not have the right attention and the employees lost their interest. The business was not a success—the firm failed. They were not managers. John Wanamaker comes along—takes the same store—handles about the same line of goods—same crowd is passing along the streets—great attention is given to

patrons—John Wanamaker attends to the business personally. He has a genius for merchandising, knows how to advertise, is a born trader. The result is a great success. What better commentary on management can there be? What more can be said in favor of compensating a good executive liberally for achieving results, or to show that bad management at any price is extravagance?

Whatever you do, do it with all your might. The battle of life, the material side of it, is a game, and the better you play it the better you will like it. Play it to win.

It is a game of the survival of the fittest. If you fail to win, it will be your fault. If you play it fair, if you are a man of integrity, if you are a decent citizen, if you do your best, I am sure great fame and fortune will wait on many of you.

You should take an animated interest in public affairs; you owe your country that. It is not only essential that every good citizen be alive to what is going on in state affairs from the standpoint of government, but it is a duty and you will also find it a diversion.

Be natural—do not pretend to be something that you are not. It is much more gratifying to be taken at your real value than to have people discover you are not what you pretend to be.

Some one has jocularly said the difference between reputation and character is, that the first is a necessity and the second is a luxury. Reputation is the estimate others put upon you and character is what you really are. Too much attention cannot be used in the formation of character. The character of the British is what has made England great.

A technical education teaches you how to do things, but nothing but your own force of will-power will *make* you do things. Others can tell you how and what to do, but self alone will do them. Many a good man has failed to accomplish much in this world because he was lazy. Timidity is another weakness to be avoided. A man should neither be too bashful nor too forward. Many a man of ability has been afraid to approach others higher up in the world and by so doing continued in a rut, when he would have been a great success if his capacity had been given an oppor-

tunity. There is not much difference between men, and the nearer you get to captains of industry, eminent financiers and multi-millionaires and others higher up in the business world, the more you will see their close resemblance to other human beings; and the more you will discover, as a rule, that they started out in life with nothing half so promising as a technical education; all many of them had was a desire to work, determination to win and good judgment; the nearer you get to this class the greater your appreciation of the fact also that they are looking for skill, good sense and honest men for important places which they have to offer to the right men. There are any number of twenty-five to fifty thousand dollar positions looking for men who can competently fill them. In addition to becoming very useful citizens generally, I hope it will not be long before each of you is filling one of these places to your own and everybody's satisfaction.

None of you will be contented, however, merely to do well in a material way. You should have a higher ambition than mere wealth. You should aspire to do something that will be of advantage to all mankind.

I know of no point to start from on life's journey that is in any way superior to, or more promising than, the beginning you are making to-day from the graduating class of Stevens Institute; and I congratulate both the class and the institute on the great things you are bound to accomplish on the trip you are about to make.

ADDRESS TO THE CLASS OF 1908

By

Henry S. Pritchett

These commencement days are good occasions for all of us, and it is worth while reminding ourselves now and again, with the passage of these soldiers of industry into the active life of the world, of just what the commencement day means; how it is that it has come to be a celebration distinct in its own significance; what the customs were of the old academic life which brought it about and what these traditions mean to us—for the traditions of this day hark back to some of the oldest of the European universities. The very academic garb which we wear is an inheritance from the great English colleges, and the term "commencement" itself has come down to us from the old-time usage of Cambridge, some five hundred or six hundred years ago. The term "commencement" has almost been forgotten in its original sense; and now and again one sees the inquiry, which I remember to have heard voiced many years ago in a college far distant from this, where the June roses, nevertheless, bloom just as sweetly and where the graduation exercises meant, perhaps, just as much. I remember hearing the old colored janitor of the college say: "What does this hyer 'commencement' mean? It seems to me we talks about commencement just at the time when we close up the buildings and everybody goes away. It seems to me," said he, "that that ought to be the ending, not the commencement."

It is worth remembering that the term "commencement" came, in the old academic life of Cambridge, from the custom that then the teacher received his title "master"—*magister* in the Latin—the origin of our own English word "mister," a word which it is all the greater honor to be permitted to have as a title in these days when the title of "colonel" can be won so easily. In that old-time college life at Cambridge, five or six hundred years ago, commencement day meant that the "master" that day came into the exercise of his power; that the "master" that day came into the practice of his profession; that that day commenced the actual

exercise of the influence and the power of the man who had been educated; and so to you men who go out as engineers, commencement means to you, of all others, the beginning of the practice of a profession; and as I have thought to-day over what might be said to you, briefly, by a fellow member of your class, one of the surviving flowers who has yet lived after the "weeding-out" process has borne its perfect fruit, it has seemed to me that, perhaps, I could do you no better service than to quote to you the words of two men, one a great American engineer, the other a great English philosopher. I heard once an engineer who had spent a long and an able life in the practice of his profession, addressed somewhat cavalierly by a representative of a business firm, who said to him: "You are in the business of engineering, I believe?" "Excuse me," said the engineer, "I am in the *profession* of the engineer." And the other word which I should like to commend to you is the word of Francis Bacon in the introduction of that remarkable volume, "The Maxims of the Law," in which he says: "I hold that every man is a debtor to his profession."

In other words, I venture to ask you to carry forward into your practice from to-day's occasion these two simple reflections: First, that, as graduates of an institution of learning, as trained engineers, you are going into the profession of engineering, not into the business of engineering; and secondly, that, as members of one of the great professions, each one of you is a debtor to that profession.

What is the difference between a business and a profession? Both a business and a profession are alike honorable callings, but the world has agreed that there shall be attached to some great vocations the title "profession," because it assumes that these callings carry with them unusual obligations; callings which involve not only energy and ability and right thinking, the power to organize, the power to get out results, but also carry with them the obligation of honor to the calling itself and the obligation of service to humanity and to the things which humanity needs; and the difference between a business and a profession, as the world looks at them to-day, is that, in the calling of a business the man undertakes honestly, heartily, sincerely to advance his

own interest without assuming any formal obligation to the social order, while in a profession a man also undertakes heartily, energetically, sincerely to advance his own interest, but with the distinct obligation to serve also the larger cause of humanity and of civilization; and with the distinct obligation that, whenever the lines of this higher duty interfere, personal interest and personal advantage must give way—and this is to-day the difference, as the world defines it, between a profession and a business.

The rise of these great professions which the world recognizes is the story of the rise of civilization itself. If one goes back far enough he finds that there were no professions, no particular callings differentiated from the general business of society and the general business of the world. Gradually there have emerged the profession of the minister, the man who gives his life to impressing upon his fellow men a higher moral obligation; the profession of the law, followed by the man who devotes himself to that calling which shall bring man into justice, into truth, into the right exercise of his civil rights; the profession of the physician, who ministers to human suffering and promotes human health; and within these last fifty years there has been admitted also among these great professions, the engineer, the man of science, the man who, taking the forces of nature, has welded them into a useful machine for the advancement of civilization and for the conservation of that which civilization serves; and so to-day these men who go out as engineers are members of a small group of the great professions, of which the world demands not only an efficient service, but also obligations which are greater than those of a business or of an occupation which aims primarily at the advancement of the individual.

Sometimes these callings have not remembered this obligation; sometimes these great vocations which we call professions have fallen below the demands which society makes upon a profession; sometimes these professions have sunk into a business rather than into a profession. Within a short time a distinguished representative of the law has called attention to the modern lack of respect for law in our country, to the fact that law is not observed by Americans with anything like the faithfulness or the accuracy or

the respect which is given to the observance of law in some other civilized countries. He pointed out some of the difficulties which lawyers find in promoting that observance, and I venture to suggest one great difficulty which was not touched upon, and that is the difficulty in the profession of the law itself, for many of those who stand to-day for the law are in the business of the law, not in the profession of the law. They are men who are giving their energies, their intellect, their intelligence, to the service of men whose purpose is not to obey the law, but to evade the law; and the man, whether he be preacher or lawyer or doctor or engineer, who serves any other man or any corporation from the standpoint of a business which may absolutely command his services, rather than from the standpoint of a profession to which he gives his service loyally, energetically, heartily but always with reference to the larger obligation and the larger duty—that man who gives his services unreservedly, without thinking of the larger duty and the larger obligations, has got into the business of preaching, into the business of the law, into the business of medicine, into the business of engineering, not into its profession. This, gentlemen, is really the distinguishing difference between our engineering profession of to-day and the engineering vocation of a thousand years ago.

I think we sometimes assume that the engineer has come into one of the learned professions, that the man of science has been admitted into the company of the great professions, because of the magnitude of his present-day work. I apprehend that that is a mistake. The engineer has, in all the centuries of civilization, been he who applied the science of his time to the practical problems of humanity; and the engineers who raised the Pyramids, who built the temples of Karnak, who built the Babylonian gardens carried out works as great in their day as anything which we have done. The essential difference between the engineer of to-day and the engineer of a thousand years ago, is that the engineer of to-day is in a profession, and he is in a profession because he has assumed the obligations which every profession must assume to society before it is elevated into the dignity of a profession in the eyes of the world.

And what is the debt which a man owes to his profession? How can that debt be paid? Does it mean—and these ideas mean nothing unless they can be put into practice—does it mean that when the engineer is employed by some contractor or by some engineering firm or by some capitalist, that he is to stop and consider whether he shall serve his employer or whether he shall serve the public interest? Does it mean that if the engineer has conscientious scruples about the development of water powers or the enlargement of a gas plant or the extension of an electric railroad, that he has to go to the firm and state to them that, this being against the public interest, he does not find himself able to carry it out? Does it mean that the obligation of a profession involves that a man should always be testing and examining and questioning every act of the man who employs him or the firm for which he works? It doesn't mean that, but it does mean this, in my judgment: that when a man works for a corporation—and most of you will work for corporations if you make a living at all—when a man works for a corporation, it means that he must not surrender his own ideal and his own sense of responsibility to the public good and to the public service, and that it is a part of his duty to raise the question of the right of the public as well as a part of his duty to serve intelligently and honestly the corporation which employs him. No man gives up his individual responsibility as a member of the body politic, least of all does he who belongs to a great profession, when he goes into the employ of any corporation or into the employ of any individual. And the chief difference between the engineer of a thousand years ago, who was a workman, and the engineer of to-day, who is in a profession, is that the engineer of a thousand years ago, the workman, was bought and sold and hired to do this or that as he might be ordered; the engineer of to-day is the man who has to do the thinking and to carry out the work, all in full respect to the obligations of loyalty to his employer, but also never forgetting that he owes two debts to his profession, one the debt of honor and the other the debt of service. He who goes into the employ of a great corporation can never forget that howsoever great may be his obligations as an engineer, he has always obligations above

those, which insist that he shall never cross the line which compromises the honor of his profession or lose sight of its duty to the great interests of the state and the nation. And these two obligations, of loyalty to the employer, faithfulness to him who pays your salary, intelligent service to him whom you serve, in nearly all cases run side by side with the larger duty and the larger service; and when those exceptional cases come, when they do not run parallel, then the engineer must remember that he belongs to a profession, not to a business.

And so, gentlemen, I venture, in this somewhat desultory and fragmentary way, to point to you the sayings of two great men, one a member of our own profession, the other a member of that other great profession of the law, so often associated with our own, each speaking a truth which each of us may well remember, a truth which indicates, first, the honor of belonging to a profession; secondly the responsibility which that honor brings. And I venture to add, as a last word, that he who looks forward into the future of his own career and who has high ambitions as an engineer, he who expects some day to gather into his hands the strings of influence and of power that may bring returns of salary, of honor, and of credit, he is the man who ought last to forget the obligations of a profession; for, however well we may learn to develop things which deal with the physical properties of the materials upon which we operate, however successful we may be as chemists or as physicists or as engineers, it is still, nevertheless, true that these world-old principles of honor and truth and justice bear a fruitage not only in satisfaction, not only in the belonging to a profession which observes such ideals, but they bring also, in the end, the only right reward to which any engineer or to which any professional man may come. He who does honor to his profession, who does not forget his debt to it, will have the larger success in the development of the matters which are temporary and utilitarian, when he remembers also the things which are spiritual and which are eternal.

ADDRESS TO THE CLASS OF 1909

By

Julian Kennedy

I esteem it an honor and privilege to be with you, gentlemen of the graduating class, on this commencement day to congratulate you on the splendid work you have done during your academic course and to say a word of encouragement to you on your entrance upon the broader and possibly more strenuous work of life. What that work will be it is hard to predict. Most of you look forward to being engineers and to doing your share in the work of utilizing nature's forces for man's benefit. Ten years from now, however, will find many of you in other lines of work, but the chances are that more of your number will be engaged in engineering than in any other profession or occupation. Whether your future work is in engineering or other lines of work, you will find that the training you have received from your Alma Mater will be invaluable to you. Perhaps some of you may become lawyers, in which event you will find that the training in mathematics and clear and intelligent reasoning given in your course here will be as valuable to you and fit you for your work probably as well as any preliminary training that you could receive anywhere. Any one reading the wonderfully clear arguments of Senator Elihu Root or the magnificent analyses of conditions made by Governor Hughes of New York could almost tell without other information that each of them had been a professor of engineering and mathematics in his younger days; and for a profession which involves close reasoning and clear thinking, it is doubtful whether a much better preliminary preparation could be obtained than you have received in your course at Stevens.

Assuming that the majority of you will follow engineering pursuits, it may not be amiss to mention some things which you will have to deal with in your future work. It is entirely unnecessary

for me to remind you that most of you are not at the present time engineers. Those of you who have properly utilized your opportunities have received a splendid mental training, together with some knowledge of engineering, which equips you to go on and acquire the vast amount of practical knowledge necessary to the engineer. You will soon find that many kinds of knowledge which you have perhaps considered useless, are important and essential in your professional work. It is a mistake made by most students, and I have no doubt many of you have made it, to think that the faculty of the school have introduced too many general studies into the course instead of giving all, or nearly all, of the time to purely technical studies and practical work closely related to engineering. To those of you who have had this feeling, I would only say that your views will change as you go on and in ten years from now you will think more of the judgment of the faculty in these matters than you do at present. There is no doubt that your instructors could map out a course which would turn out graduates who would be able to start in practical work with much more ease and readiness than you can; in fact any boy who had spent the four years you have spent here, in the field or the drawing room learning practical engineering, would, other things being equal, be able to do routine work in an engineering office much better than you could do it, but, on the other hand, in a very few years you should be far ahead of him. In other words, your instructors have been wise to give you a broad and liberal training, and to forego teaching you some of those things which would come nearest to making engineers of you at the time you finish your course in order to give you more of the broad and fundamental principles, the mastery of which will enable you in a reasonable time to become much abler and more valuable engineers than if your training here had aimed to teach you the maximum amount of that kind of technical information which is supposed to be most immediately useful to the young graduate. It is much better for you to have a broad, liberal education and a little engineering knowledge when you leave here than to have a much greater amount of practical and technical knowledge without a liberal education. In your future work

you will learn that it is much easier to find among technical graduates good designers of machinery or fine mathematicians than it is to find those who can write a satisfactory contract or even a good business letter.

At some stage of your career, some of you at least will be called upon to purchase large amounts of machinery and materials, when you will find that the ability to write a contract from which not one word can be omitted and of which not one sentence can be construed in more than one way, will be of more value to you than even the knowledge of the method of least squares, which some of you may perchance have forgotten by that time. Not only will your opinion of the judgment of the faculty change, but your general impressions of them will also be radically revised. In my student days there was a song, the refrain of which was, "There'll be no faculty there"; but after graduating you will begin to appreciate the faculty and year by year this appreciation will grow stronger until you will finally arrive at a somewhat adequate idea of what you owe to them, and to realize that not to its buildings, not to its endowment, not to its alumni does your Institute owe its greatness, but more than all to these combined to that noble, earnest, unselfish, self-sacrificing band of men, its faculty, and as the years roll round you will appreciate how many of them have given up the chance to much greater material reward in other lines of work in order to do the more important work of fitting you to be an honor to your school and a benefit to the world, and at the end of a quarter of a century those of you who are living will be amazed at the interest taken in you one and all by the faculty who, like a mother, never forget their boys and grieve over their misfortunes and glory in their success.

Speaking of mothers brings to mind mothers-in-law. Like college faculties, they are often the subject of jokes, but if you will observe carefully and accept the verdict of those who have had experience, you will learn that one of the truest and best friends a man has in this world is apt to be his mother-in-law. In this connection, I may say that one of the things most essential to his success, which a young engineer should do not too late in his career, is to acquire a mother-in-law.

I have spoken of the engineers purchasing materials and making contracts, which leads to the thought that a large part of engineering is commercial, and that commercial considerations must be given weight in all engineering work. We are sometimes inclined to forego these and strive to produce something ideal, without reference to the question of whether it will be profitable or not. The man who puts in an elaborately designed machine to displace two laborers in a plant and finds that instead of them he has one skilled man operating the machine and two high-priced machinists keeping it in repair, may be a genius and a skillful mechanician, but he is not accomplishing what is generally wanted. You will be surprised when you get into actual work to find how often commercial conditions are ignored by engineers, and not by engineers only. It may be your experience at some time to work hard for weeks at the urgent demand of a board of directors to try to reduce the cost of labor in a plant by five or ten cents per ton of product and you may spend many thousand dollars to accomplish this, while at the same time the output of the works is being sold year in and year out at a dollar or two a ton below the price it ought to bring. You will find also in many cases that costly machines are installed to effect savings which are offset many times over by the interest on the cost of the machinery and its maintenance. You will also find installed elaborate and intricate machinery to effect the highest ultimate saving, which because of the complication becomes unreliable and subject to breakage, and you will be surprised to find in how many cases an hour's stoppage of a machine which forms part of a large and highly organized plant will cause a loss of more money than would be saved in a year by this highly efficient machine as compared with a less efficient but thoroughly reliable one. The larger and more complicated a plant is and more highly organized the sequence of operations carried on in it, the more important it is that all machinery in it should first of all be as reliable as it can be made. It should, therefore, be your aim to acquire as rapidly as possible, in addition to your mechanical ability, good commercial judgment and a wide experience, enabling you to judge which of several different paths is

apt to lead to commercial success. In purchasing materials the engineer often has to act as the agent of his clients as well as a referee between them and the seller. It is, of course, his duty to get materials as cheaply as possible, but he should never forget that he ought to be absolutely fair to both parties, and the engineer who maintains this attitude will in the long run best serve the interests of his clients as well as his own. In doing business he should remember that nine tenths of the litigation in this world is caused by vague or incomplete understandings between buyer and seller, and he should exercise great care to see that everything connected with the specifications and contract is so fully and clearly expressed that there can be no misunderstanding regarding them, and he will find that to do this is by no means an easy or simple undertaking.

In starting out as engineers, you should all bear in mind that you are largely dependent on others. The field of engineering is so vast that no one can cover a very large part of it, and no one can accomplish much unless he has the faculty of availing himself of the work and knowledge of others. The man who makes one of the greatest failures in the mechanical world is he who spends his life inventing complicated machines, only to find that others had invented them years before. In many lines of work it is just as important to know what has already been done as it is to possess great ability to originate new designs, and as between the man who is an expert special designer in any department of engineering and the one who has the faculty of utilizing the work of many other men in many departments, the latter will be the more valuable man, will be more sought after and will rise higher in his profession. In other words, it is not so much what a man can do himself as what he can get others to do that makes him valuable in carrying on large undertakings.

In your work as engineers you will be called upon to make reports on properties, processes, etc. You will, of course, in such cases be sure that you understand the subject, after which it will be wise for you to write your report so as to say in it all you desire to say and write it on the theory that anyone may read it. You may be asked sometimes to vary the wording of your report

on the ground that it is not to be published, but only shown to A or B. In such cases you will be wise to make no changes which you would not want read and criticised by anyone, and to bear in mind also that the funds of widows and orphans may be invested in enterprises on the strength of your report. Your written report should, of course, be complete in itself and should not need to be supplemented by oral explanations, and it should be so concise and clear that there is no possibility of anyone warping or distorting the meaning of it. While most business men want straight, honest reports, there is quite a respectable (as to numbers) minority who will try to have you warp the truth just a little, and who are very plausible and specious in the way they go about it. In work of this kind you will find that commercial knowledge and good judgment play a very large part, and you will possibly learn that expert accountants, like many other kinds of expert specialists, are very narrow in their views and more or less feeble in grasping broad principles. To be successful in this line of work it is necessary that you should acquire a great deal of general information in connection with accounts, construction of plants and their operation. You will also find many things in works which cannot be seen, and for your information in regard to them you will be dependent upon other people, and your success in getting accurate information will depend largely upon your judgment of men, your tact and ability to elicit correct information from them. Owing to the large number of things which have to be examined sometimes in a very short space of time, it will be necessary for you to acquire a faculty of seeing things quickly and accurately, as well as of judging of their conditions and their method of operation. This is a faculty which varies greatly in different men, but one which can be cultivated to a marvelous extent.

You have doubtless seen men who could walk through a factory and come out with a wonderful amount of information regarding the workings of a large number of intricate machines, whereas another man may have passed through at the same time and not seen a hundredth part as much of the actual inwardness of the mechanism. In making reports in regard to works or

plants, you should be as concise and clear in your descriptions as possible, bearing in mind that bankers and financial men generally are apt to place upon a report a value in inverse proportion to its length. I remember seeing a report on a large plant containing some miles of railroad trestle, which gave in exact detail the size of every sill, every post, cap, corbel and stringer in the entire works, the list occupying a good many pages of legal cap; and the entire trestle was rotten to an extent that it was not even fit for firewood and the only thing that was really necessary to know about it was the expense of pulling it down and hauling it away. The man who made this report was probably a very painstaking engineer, but lacked something in his make-up.

You will in your future work, doubtless, be called on to testify as experts in the courts in cases involving mechanical considerations and patents. There has been a good deal of criticism of the system of having experts on each side of a case, and many have recommended that the court should engage its own expert, but all things considered, I have no doubt that a fuller and fairer knowledge is gained by the court if it listens to two experts each putting forward the strong arguments for his own side of the case, than if only one expert is heard, as he is liable not to see all sides of the question, and may, with the best intentions in the world, give a very incomplete and erroneous opinion on the technical points of the case. This is less likely to happen where each expert sets forth his own side of the matter, and is cross-examined by the other side. Should you have occasion to act as an expert in this line you should first of all be sure that you have a thorough knowledge of the subject; in other words, that you are a real expert in it. Next you should endeavor to be entirely fair in your testimony. It is not expected that you should volunteer aid or assistance to the other side, but you should answer all questions fully and fairly and, above all, you should be absolutely honest in regard to your opinions. As a general rule, it is wise not to enter a case unless a preliminary study of it convinces you that you can be of service to your client, and at the same time adhere strictly to your honest opinions throughout. You will find it essential in this kind of work to be patient, to have absolute

control of your temper, and to meet the most insulting and irritating cross-examination with unruffled composure and with retorts courteous. Where the facts are against your side, you should not try to dodge the issue but remember that frank admissions of those things which plainly favor the opposition in most cases help your side more than they hurt it. Remember always that although it may be impossible to prove that a statement of an opinion is not truthful, yet an experienced judge in reading the testimony will almost infallibly detect any tendency to untruthfulness or unfairness in a witness.

In your engineering work you will possibly have to direct large bodies of men, and here you will need judgment, tact and knowledge of human nature, together with firmness and decision and a spirit of fairness. In addition to handling men successfully, you should make it a rule to learn from them and you will be surprised at the great amount of information you can gather in this way, especially among mechanics. Twenty or thirty years ago there was among the so-called practical mechanical men of this country, a good deal of contempt for the technical graduate. This feeling has to a large extent ceased to exist, but on the other hand I fear there is a tendency on the part of the technically trained man at the present time to greatly underestimate the value of the knowledge of the first-class mechanic acquired by long practical experience. Many engineers would rise much higher in their profession if they had the faculty of absorbing useful information from the working mechanics, many of whom have wonderful ability, and can give most valuable information. In a still wider sense engineers can get a great deal of information from their brother engineers, and team work is just as essential in carrying on engineering work as it is in winning a game of football. As you can obtain a large amount of aid from other engineers, so it should be your duty and your pleasure to impart information to your engineering brethren, especially to the younger members of the guild. Make friends among men of high standing and greater experience than your own and hold them. Always see a desirable position ahead of you and strive to be prepared for it mentally and physically. Remember that

often a strong constitution and a vigorous brain will cause you to win where others have failed. Bear in mind that booze and business do not mix, and that the demand for sober, steady men grows stronger. In men as in machinery what is most wanted is reliability. In all things so shape your actions that if failure comes to you, you shall have done better than to achieve success without deserving it, and so that you can inscribe upon the dismantled mill or the abandoned mine "all is lost save honor."

Gentlemen of the graduating class, I congratulate you upon the future which looms up before you. The great advances in science, mechanics and all the forms of material and mental development achieved during the last fifty years will be dwarfed by those of the next half century. Your native land possesses most marvelous resources and boundless possibilities. Its great forests which should be conserved and increased, its vast water powers to be developed, its great stores of fuel to be economically utilized, and other natural resources too numerous to mention, all of which should be used in the most efficient manner, call for earnest, faithful and intelligent engineering work.

A part of this work it will be your good fortune to do, and I have no doubt you will do it vigorously and faithfully, and will receive the reward which follows work well done. You will find discouragements, but these come to others as well as to engineers. The financial rewards of your work may seem small as compared with those common in other professions, but there are other rewards beside these. The man who builds a successful machine enjoys a pleasure which the owner of it does not, and the engineer who sees scattered over the country great plants which he has designed, doing their work well, obtains a great reward even if the financial return to him is small compared with that received by the stockholders.

In addition to the work which you will find to do in the line of engineering, it is to be hoped that your influence will be widely felt in other directions. There are many problems in connection with the municipal, state and national government that will require solving in the years to come, and no class of men should be more able to cast their influence in the right direction in the

solution of these than the engineers. When you consider that the cost of building and maintaining one modern battleship is greater than the amount necessary to endow and operate Harvard University, Yale University and Stevens Institute, or again that the first cost of one of these vessels would build five thousand model workmen's homes costing $3,000 each, and when we see further the insane rivalry between such great powers as England and Germany to see who shall have the most of these engines of destruction, while at the same time both countries are rapidly drifting toward bankruptcy, it seems as though the time was ripe for educated men and everyone else to use their influence on every possible occasion against this species of folly.

When we further notice the so-called alleged statesmen who represent the various portions of our country at Washington quibbling over trifles and striving with all their might to get all the plunder out of the public crib for their own districts, and failing to take any action on the great questions which would be of untold benefit to their country, it impresses us with the fact that there are needed in this country a great many clear-headed, courageous men who can think straight and are not afraid to express their opinions. There are, and will be, many important questions arising, and it should be your duty and your pleasure to use your influence at all times in favor of any policy that will make for the good of your country and your fellow man.

I trust you will not be content to be simply skilled mechanical specialists of the type that looks with contempt upon Shakespeare and Milton because they knew nothing of alternating current generators or Pelton water wheels, but that you will strive to acquire a broad and liberal culture, kindly sympathy and sound judgment; that your influence will be steadily exerted in behalf of all things that are of good report in social, civic and national life, and that wheresoever you may be at all times and in all places your Alma Mater may be proud of you, and that your country and the world may be better for your having lived in it.

To you, gentlemen of the graduating class, who, by successfully completing the thorough and strenuous course demanded of

you by this Institute, have demonstrated that you will have the ability and industry to acquit yourselves with credit in any work your hand may find to do, my parting greeting is,

"Well done and go forward."

ADDRESS TO THE CLASS OF 1910

By

Walter M. McFarland

The profession of engineering is very old. If this statement should surprise you, think for a moment of some of the great engineering works of antiquity, such as the pyramids, the hanging gardens and irrigation system of Babylon, the great aqueducts, tunnels and roads of Rome, the wonderful buildings, those remarkably well worked out specimens of naval architecture, the triremes, and the military engines such as the catapult and ballista. The idea may not have occurred to you, as it did not to me until a few years ago, that these ancient monuments represent a stage of development which proves that these nations had already existed for a long time. For us as engineers they prove that the art of construction and the science of engineering had also been developing for many years.

We have no records of engineering schools in those early days, although works on engineering were issued near the beginning of our era; but perhaps, if we remember that engineers have always been given rather to doing things than to telling about them, we can understand that there may have been engineering schools. We have heard much of the School of Philosophy in the Groves of the Academy, where Plato was the great teacher, but the men educated there made it their business to write and to teach.

With respect to our own branch of engineering the history of the distant past is hazy, although we have the biblical notice of Tubal-cain, of the seventh generation from Adam, "the instructor of every artificer in brass and iron," and therefore our great professional ancestor, as well as the first technical professor on record.

It is a fact, which you younger men will verify as you grow older, that scientific explanation almost invariably follows the observed phenomenon instead of preceding it. For an absolutely

new case this would seem almost inevitable, but it seems to be true very often even where the phenomena, on careful investigation, prove to be special cases of some general law. The application of this point is that before there could be a recognized profession of mechanical engineering there was necessary the existence and recognition of many phenomena and some degree of order in the arrangement of such knowledge. This, of course, is one of the definitions of science, "the orderly arrangement of knowledge." While there was undoubtedly a large amount of work which might properly be considered as mechanical engineering dating from very far back (and the excavations of Pompeii have shown us small water tube boilers, plumbing, etc., of the first century A. D., not to mention the splendid work of Archimedes in the third century B. C. and the steam turbine of Hero, nearly two thousand years ago), it would probably not be far wrong to say that the beginning of the profession in its modern sense counts from the time of James Watt, who took the steam engine, when it was useful but very inefficient, and so improved it as to leave little for his successors except refinement in detail. That takes us to about the time of our Revolutionary War, and thus makes the profession in its modern sense somewhat more than a century and a quarter old.

Instruction in some branches of the knowledge ancillary to the profession has, of course, been a part of the curriculum of colleges and universities for a great many years, but without attempting to give an exact date, it is safe to say that really complete, systematic instruction in mechanical engineering has only been carried on for about three quarters of a century. Indeed, while Stevens was not the first institution to give instruction in mechanical engineering, it was the first one where that was made the chief aim.

If we look over the list of the leaders in manufacturing and other pursuits which depend on mechanical engineering at the present time, and note that it is the exception when they are not graduates of a technical school, we would be prepared to say that the usefulness of engineering education has been so thoroughly established that it is idle to discuss it. However,

remembering the words of St. Paul, "Prove all things, hold fast that which is good," and following such good advice we may with profit, perhaps, discuss the subject briefly, so as to feel assured that the work is proceeding along correct lines, or, if any changes are desirable, we may consider them.

While I have not the slightest doubt of the absolute necessity for technical education, and that in the main the methods followed are correct, it is nevertheless a fact that there is not complete agreement as to the value of our present system of education, nor as to its details. Some of the critics are so obviously ill-informed and biased that it is hardly worth while to consider what they say. Others are men who have themselves passed through the engineering schools and have made their mark in the profession, and their opinions are at least entitled to respectful consideration.

In any such discussion it is important, first of all, to know just exactly what is meant by the terms we use, and I am inclined to think that much of the criticism is based on an erroneous definition of education. The etymology of the word, as you well know, means to "draw out" or develop, and I believe that the intelligent arrangement of the course of instruction, in accordance with this definition, is all that can be reasonably demanded of the technical schools. Some of the critics, to judge from their statements, seem to expect that the schools should do much more than train the young men, although, when we think that the training given by an efficient school develops mind and character, hand and eye, we realize that we are asking a great deal. In addition, the critics seem to expect that a young man shall be turned out at twenty-one or twenty-two years of age, after a four years' course, with the stored-up experience and mature judgment which ordinarily only come to a man of forty. They doubtless do not intend it as such, but it seems to me that this is one of the greatest compliments which the technical schools have ever received, because they are expecting something which would be little short of a miracle. The fact is that experience and judgment can only come with repeated observation and careful analysis of the data thus obtained in connection with previous

knowledge, all of which takes time, or in other words means greater age for the engineer. We are told that the chemists have discovered methods of aging wines so that in a few months they can accomplish what Nature takes years to bring about. No chemist of the intellect, however, has thus far arisen who can perform the equivalent process for the human mind.

The technical school does, however, give the graduate one enormous advantage in addition to his intellectual training, namely, the record, complete to date, of what others have done in the profession, and with a knowledge of where to go to seek for precedents; so that, although the experience and mature judgment are still lacking, when problems arise which are unfamiliar he knows where to go to get light on them.

It seems to me so unreasonable to expect that a technical graduate shall be able to step into a factory or a consulting engineer's office and immediately do the work of leading men who have had years of experience, that it has been a constant surprise that men whom I know to be of great ability should entertain such a view, and yet it is a fact. It is somewhat akin to the talk which was very common when I finished my technical schooling, and which has now largely disappeared, about the relative merits of practical and theoretical men. Men were called "practical" usually when they had not been to a technical school, but had served a regular apprenticeship in some shop, and such systematic knowledge as they possessed came from reading or study without the guidance of teachers. The "theoretical" men were those who came from the schools, and whose manual training was, of course, very much inferior, and only such as could be obtained in the workshops of the school or college. As almost all of the older men were "practical," they professed a great contempt for the young men from the schools, and never wearied of pointing out how useless they were. What it really amounted to was this: these "practical" men, being older, had had numerous opportunities for observing the solution of certain classes of problems which had not as yet come to the attention of the younger men. Consequently, when such a case arose, the practical man could tell at once how to do it, while the man of

the schools had to take some time to study it out. Frequently, however, a case would arise which was absolutely new to the practical man as well as to the other, and then, almost invariably, it was the theoretical man who found the solution. In other words, he now had an opportunity to prove the real value of technical education in having taught him how to think, how to analyze a problem, and how to apply his knowledge to its solution. I have not only had this happen often in my own experience, but I have run across it repeatedly with other technical graduates, and I have no doubt that every other engineer here could give similar illustrations.

There are certain disputed questions with respect to the course of instruction which probably will never meet with a solution satisfactory to all, because opinions differ so much—such as whether attendance at the technical school should follow immediately after preparatory work or should come after an interval which had been spent in the shops, or whether what the English call the "sandwich system," a variation of which is being tried at the present time in Cincinnati, would be better. There are arguments of weight to be advanced on both sides of these various questions; it has always seemed to me, however, that it is better to make the technical school the completion and rounding out of education, when the habit of study is still strong, rather than to break in on the course with loss of these habits and difficulty of taking them up again later.

Another side of the question, however, has come up in recent years, and is, I believe, a just criticism against the older course of instruction, namely, that sufficient attention had not been given to the commercial side of engineering. I hardly think that the pioneers who developed the technical schools are entirely to blame for this, because from the very nature of things most of them were without commercial experience, so that its importance did not appeal to them. Moreover, the amount of instruction which has to be crowded into the usual four years is so great that they might well be pardoned if they were inclined to pay more attention to general principles and to grounding the student thoroughly in them than thinking about their application, know-

ing that this would come after graduation. It was doubtless the observation of this undeveloped commercial sense that caused some manufacturers and other employers to criticise the technical graduates at first, and to say that they were of no use to them. It is especially gratifying to remind this audience that your own president, Dr. Humphreys, was the first head of any technical school to establish a course on the commercial side of engineering, and it was peculiarly fortunate for Stevens that he took this chair himself, because of his own high standing in the commercial world.

It is perhaps very natural for professors whose specialty is mathematics, strength of materials, machine design, etc., where the limited time requires them to dwell particularly on the engineering side of the problem, to overlook or omit reference to the commercial element, but in the hard world of business the element of cost is the one which ranks first. Machines and structures must be strong and efficient, but above all it must be possible to construct them for such a price as will permit of a profit both to the manufacturer and to the user. In other words, no matter how satisfactory a machine may be from the standpoint of strength, efficiency and adaptability, if it cannot be sold at a profit it is a failure, and the engineer who has designed it without taking into account the question of costs has failed just as completely as though it had proved inefficient or had broken down under test. It would be unreasonable to expect the technical schools to go into the question of costs in the same detail as the factories, but the point is that the importance of minimum costs must be emphasized to the students so that it will not come to them as a revelation after graduation.

An effort has also been made to choose the problems which have to be solved in the classroom so that they bear some relation to the kind of work which the students will have to do after graduation. In other words, the problems are not abstract, but very concrete, and are taken from those which recur frequently in engineering practice. This change is somewhat akin to that made in modern languages, where the sentences to be learned are now those which will be of some use in real life, and not such

gems of thought, used purely for grammatical illustration, as the time-honored one, "Have you the green umbrella of my wife's grandmother?" In the drawing room something of the same sort holds, and I know by experience that it is possible to give the students in regular work such knowledge of technique that when they go into the drawing room of a factory they will not feel strange, but can at once do commercial work, only having to learn the particular difficulties of that factory.

The assertion made by some of the critics of technical education, that an engineer can get adequate training in the shop, is completely disproved by the experience of some of our largest manufacturing companies who have found it necessary, in order to get properly trained men for their higher positions, to establish a special apprenticeship course for engineer graduates, and offer them special inducements to come. The object of this course is to familiarize them thoroughly with the details of the particular line of business which they could not, of course, get in the schools, and when this course, which only lasts a couple of years or less, is finished, the young men can start their higher work, in which promotion is steady and the reward for unusual ability is very great. It is to be noted particularly that this is a matter of business, and not philanthropy, to which the employers were driven by necessity and these employers would be just as willing to give these higher positions to their trades apprentices if they had the necessary mental training and ability to fill them.

I know of a case where one large factory rather neglected this matter for a year or two, and they found that they were losing out in competition, so that they then offered special inducements to the technical graduates to come to them.

In this matter I do not speak at random or in general terms, for I have just left one of the largest concerns in the country, after eleven years of service, and have watched the whole apprenticeship system and the career of the college graduate with the greatest possible interest. The exceptions are so rare that I am entitled to say that every position of prominence outside of the financial department is filled by a technical graduate. Within

the last few years a night school was established, whose instructors were principally engineers and others with a technical education, and some of the graduates of this school (trades apprentices who thus made up for the deficiency in their early education) have qualified themselves for taking higher positions.

To the claim that a shop training alone is sufficient to make a man a competent engineer at the present time, it seems to me a sufficient answer is the existence of the correspondence schools. The young men who take the work of these schools are to a very large extent skilled workmen who have not had the advantages of a thorough education, and who are wise enough to see that they will not be competent to take higher places without greater mental development.

Right along this line I may mention a case which came within my own experience some years ago, when I was connected with Cornell University, where a number of young men, from twenty-five to thirty years of age, who were journeymen machinists, came to Cornell in accordance with a provision for special students, their object being to get thorough training in mechanical drawing and an elementary knowledge of the theory of engineering. These men had saved the necessary money and were paying their own way. Indeed, in some respects, they were the most earnest and satisfactory students I have ever seen. A rather striking comment on the thorough training to be obtained in the shop is shown by one case which I knew personally, where a man arranged to go to a technical school to get certain branches of shop work which he could not get in the shop where he was a journeyman. This shop only trained a man for some one class of work, and had no real apprenticeship system.

A writer who has said a great deal in disparagement of higher education of all kinds has asserted that the technically educated men have not made any great inventions or done any great work in engineering, and he goes back to the early days of mechanical engineering, before there were any schools, to cite Watt, Stephenson and others. It is too bad that a man at the head of a large manufacturing establishment should have forgotten that the two men who brought out the most revolutionary improvement

in shop practice in the last twenty years were technical graduates. You, of course, know very well that I mean Messrs. Taylor and White, the inventors of high speed steel, both of whom are graduates of Stevens. I have not taken the trouble to look this matter up in detail with a view to making a long list, but many names occur to me, as I am sure they will to you, such as Sir William Siemens, the father of open hearth steel; Captain Ericsson, of *Monitor* fame; Mr. James Gailey, who has made the latest developments in blast furnaces; and Julian Kennedy, who has done so much for the development of the steel industry. The invention and improvement of the telephone were entirely due to college-bred men, as you well know, and both Bell, the inventor of the 'phone, and Pupin, who has made such a revolutionary improvement, were college professors.

It is also worth noting that the men who have done the best work in devising systems of paying labor in manufacturing establishments—Halsey, Taylor, Gantt and others—are technical graduates, although it would seem that, as the "practical men" had this field to themselves for so many years, they should have been the ones to excel in this "business proposition."

When we come to the field of electrical development for light, power and traction, it is almost absolutely true that the whole development is due to college-bred men. Having been intimately connected with this class of work for more than ten years past, I am in a position to speak of this positively.

It is rather amusing to note the remarkable attitude of one critic, who decries higher education of all kinds and says the colleges are frauds. He is compelled to admit that the bulk of engineering work to-day is done by technical graduates, but he claims that they deserve little or no credit because, he says, their work is only copying what was done by the giants of the early days, when there were no technical schools. Being himself ignorant of the principles involved, he thinks it as easy a job to build a suspension or cantilever bridge of 2,000 feet span as one of 500 feet. One would have thought that the lamentable failure of the Quebec bridge would have opened his eyes, but "none are so blind as those who will not see." This same man never wearies of

disparaging the college professor, but if I remember rightly the professors were the very men who had been constantly warning the men in practice that they were making unwarranted assumptions in the case of these huge structures, based on experience with much smaller ones, and urging experiments to secure the needed information. Bridges on the principle of that at Quebec had been built for years, and almost as large. Moreover, the builders had had great experience. The failure was due to a neglect of precautions which the "college theorist" would have insisted upon.

Some of the critics seem to take the position that men who have been fortunate enough to enjoy a thorough technical education would maintain that no men without such an education could attain to eminence in the profession. I think you will rarely find any technically educated engineer of experience who would make such a claim. Every one of us has personal friends who, by extraordinary ability and great exertion, have overcome the handicap of an incomplete early education, and have by hard study put themselves in positions of great responsibility and have done splendid work. On account of these relatively few cases, to disparage education is a mark of extremely poor judgment. Because an untrained man of extraordinary physique occasionally performs some great thing in athletics, you would certainly never find anyone familiar with the training of athletes to say that such training is unnecessary. I saw a case at the revival of the Olympic games at Athens in 1896, which illustrated this point very well. The American athletes won every event in which they participated except the Marathon race and one other long-distance race. The Marathon race was won by a Greek shepherd, whose daily work had, in a sense, given him a rough training which enabled his splendid physique to bring him out the victor. In all the other events, where training does count, the skilled athletes were the victors. A close personal friend of mine, who has held some of the highest positions in the shop management of large establishments, and who is not a technical graduate himself, once told a lad who did not want to go through school, but to

take up shop work at an early age, that he was making a great mistake. Said my friend:

"I was compelled on account of family reverses to go to work when I was a boy of fourteen. By tremendous work and study I have finally reached a good position, but I want to tell you that if I had had the advantages of a technical education such as are open to you, I would have reached my present position years before I did."

It seems to me that the complete statement about technical education is that the schools and the employers to whom the graduates go after they leave should work together in a spirit of mutual helpfulness. Disparaging criticism by either party can only do harm, while friendly suggestion will be of constant benefit. The establishment here of the course in engineering economics is a proof of the readiness of the schools to respond to reasonable suggestions, and if all the employers will take the same attitude as that of the great electrical companies and some others in realizing that for their own sake, as well as that of the students, the early months in the factory should be looked upon as a sort of post-graduate course, we would have a condition of affairs which would bring about satisfaction on all sides and the maximum efficiency both in the shop and in the school.

It is almost inevitable in modern life, where wars have become infrequent and the commercial class is the dominant one, that success should be measured by wealth. Doubtless this is right enough, in a way, so long as it encourages thrift and business prudence. At the same time it certainly is not the only measure of success, and it has often seemed to me that if there is a class of men who have just reason to feel proud of their work, it is the college professors. I know that many commercial men have a way of referring to the opinions of the professors as though they were always unpractical and not worthy of much respect, but it would be easy to show that a great deal of the world's progress has been due to the quiet work of these very men. The particular point which I have in mind, however, is their great opportunity for training the mind and forming the character of the young men who are under their instruction. We are ready to pay the highest tributes to the genius of the artist, the

sculptor and the architect who work entirely with inanimate things, but what greater glory can any man ask than to have had a really essential part in the turning out of a young man with well-trained intellect and high moral character?

I am very fond of history and I sometimes think that the necessities of our technical curriculum have denied our students the great benefit which would come if they could give more attention to it. If I read history aright, it certainly teaches that the essential thing for the stability and permanence of any country is the high character of the citizens and their devotion to the state. Every one of the ancient nations began to decay when wealth became the chief aim in life and the character of the men deteriorated. It was no wonder that the hardy barbarians from the North should conquer Rome when her own sons would mutilate themselves to avoid military service. Therefore, I say that the college professor has an unusual opportunity to set a personal example of high character before his students, and he has a right to feel that his career is a success when the students whom he has helped to train fill with credit, both professionally and morally, the stations into which they come in after life.

And now just a word of congratulation and greeting to the graduating class. You have worked long and faithfully, not so much for this day and the justly prized diploma which is the testimony to your faithful work, but rather in equipping yourselves for life's battle. So much of the work of to-day that makes life easier and happier is performed by mechanical engineers that I feel you are to be congratulated upon your chosen profession. You can be very proud to have your name on the roster which has been made illustrious by the great men of the profession, and doubtless to some of you it will be given to become illustrious yourselves. I certainly hope so. Never become discouraged because you have not made some wonderful discovery, or should you not become immediately famous, for you will find as you grow to be more experienced that the great bulk of the world's work is done, not by the geniuses, but by the men who perform faithfully and conscientiously the work which devolves upon them. Mistakes will occur, because every-

one who tries hard to do things is sure to make some mistakes; but if, at the end of your career, you can conscientiously feel that your duty has always been faithfully performed, you will certainly be ready to receive the final commendation, "Well done, good and faithful servant."

ADDRESS TO THE CLASS OF 1911

By

Robert M. Thompson

I highly appreciate the honor of having been asked to address you young gentlemen on this, to you, most important day. I know a thousand pleasant duties are calling you, and if I do not later say anything that will please you, I am sure it will please you to know that I mean to make my remarks brief.

I have been asked to emphasize to you the great value of efficiency. It is surely "gilding refined gold" to advise the graduates of Stevens to be efficient. The whole course of your instruction here hews to that line. Your institution was founded and has been built up by men with whom efficiency was and is a religion. From generation to generation the Stevens family has produced men, a study of whose lives is worth a thousand essays on efficiency, and the lives of men like Morton and Humphreys are greater arguments for efficiency than any thoughts I can express. Therefore, I am not going to waste your time by attempting to instruct you how to be efficient. I assume that you will be. But I am going to ask that you be articulate in the defense of efficiency. Alas that it should be so, but in these modern days, because of a most curious misunderstanding in the public mind, "efficiency" is treated as if it were synonymous with dishonesty. If two persons, or two corporations, compete in a limited field, and one is efficient and the other inefficient, the one that is efficient succeeds and the inefficient fails. Those who fail cry out and make a great disturbance, but the efficient, busy with their affairs, do not talk, and so there has grown up in the public mind the belief that there is some wrongful reason why one set of men succeeds and another fails. The obvious, the true reason, they reject.

The time has come when good citizens must preach the gospel of efficiency. They must teach the public that those who engage in business and make money out of it are better citizens and do

better by the community than citizens who engage in the same business and lose money; for the making or losing of money in a business is a fair test of efficiency.

I want you to take a national view of production. Do not for the time being consider the rights or the wishes of individuals, but think of what is best for the nation as a whole. Evidently what we want as a nation is a sufficient supply of natural products to satisfy the needs of our own people, and enough surplus to exchange with other nations for those things we desire but do not ourselves produce. It is also desirable that, if possible, these things be so produced that opportunity may be given each individual to enjoy the intellectual as well as the physical pleasures of life. But the community can only give opportunity. The individual must fit himself to enjoy the things that are intellectual and spiritual. You cannot by legislation make a man either frugal, intelligent or happy.

As a nation, we annually produce from the ground, fashion, transport and consume an enormous amount of "real things," and the producing, fashioning and distributing of these things is what we call "business." There are in this country 90,000,000 of people. A certain number of them work on the land—some as farmers, some as planters, some as miners, and others as lumbermen. These men are producers of the "raw material" which goes to make up our annual fund. Others work on the various railways, canals and steamship lines, and transport this raw material to the points where it is to be fashioned by another body of men into the shapes in which we desire to consume it. Then comes another division of men whose business it is to redistribute the finished product to those who consume it. It is obvious that so far as the nation is concerned the important thing is that the forces of nature be fully employed, and that each unit of labor engaged in production shall so do its work that the country's annual product may be the largest possible. In other words, that each unit shall work efficiently.

If we consider the several divisions of labor in this country, we find that farmers and planters are not efficient. They have so improvidently worked the land that in many cases its fertility

has been exhausted, and the phrase "the abandoned farm" has come to be a common one.

The lumbermen have almost exhausted our forests, and have done little in the way of renewing them. We are now arranging with our neighbors on the north for a supply from their great reservoir of this natural wealth until by scientific management we are able to build up new forests which can be made to give us an ample annual supply while maintaining their capital value.

With our mines our position is different. The introduction of modern machinery and the scientific direction of labor has made the cost of working our mines the cheapest in the world. But because of inefficient management of the markets we have attracted the consuming power of the world to our mines, and we are rapidly exhausting them. Mines do not grow again as do the forests, and when once exhausted they cannot be renewed. Science can accomplish but little more in improving the methods of mining, but a scientific management of the markets may secure a more equitable return to our country for the products of our mines. Let me cite copper, for instance. At our present rate of production, it is only a question of time until our copper mines will be exhausted, and when that time comes we will be forced to buy from other nations the copper which we will still need, at a price much higher, you may believe, than the price at which we are now selling. Within my business life the production of copper, in this country, has increased from 50,000,000 pounds to over 900,000,000 pounds per year. Sixty per cent of this copper we ship to foreign countries at a price which to-day only pays for the labor involved in mining and transporting it, and yields us no return for this natural wealth which we are practically giving away. If the owners of our copper mines were to combine to-day and reduce the output of their mines by 200,000,000 pounds a year our nation would receive from the foreign countries who buy our copper more money for the smaller than we receive now for the larger quantity, and the life of the mines would be prolonged many years.

In transportation and manufacture there has been a continuous improvement in machinery, but a deterioration in the human

element. The fundamental error of the trades unions in teaching that the way to give the masses of the people more "real things" is to produce less, has made inefficient workmen, and caused the existing conflicts between capital and labor.

In distribution certain large corporations do their work efficiently, but the great mass of distribution is done by retailers, who are inefficient. The majority of the people and of the voters being inefficient, and not understanding the value of efficiency, there is a perhaps natural jealousy of those who are efficient. Especially is there jealousy of corporations which make large profits. The people do not understand that the making of large profits is evidence of efficient management, and that the greater its profits the more efficient the corporation. The people should be taught that a corporation does not retain in its treasury the "real things" which it produces, but turns them all over to the consumers, and the more it makes the better off the public, for there are more things to divide.

In exchange for its product the corporation receives a credit against the general fund of "real things," and this is divided among its stockholders. The stockholders, no matter how large their credit may be, draw against the general fund only to the amount that they consume, and the "real things" represented by their surplus credits remain in the fund and are consumed by the general public. When the knowledge *how* and the desire *to be* efficient become general our farmers and planters will be able to double the yield of our fields. A wise application of the doctrine of conservation to our forests and mines will give us annually enough for our wants and preserve for future generations their share of our supply of natural wealth. Labor doing its best, under efficient leadership, will find that in return it will receive its full share of the annual product, because the more men produce the more they will get.

There remains one other great lesson which you can help teach to the country, namely, that our working classes are *now* receiving their equitable share—perhaps more than their equitable share of the annual product; that, judged by the experience of mankind in other parts of the world, they are receiving ample to

keep them well, strong and happy, and, if thrifty, to provide a surplus which, saved and invested, will take care of them in their old age; and that if sufficient machinery be provided, and all men work efficiently, the necessary product can be obtained by such hours of labor as will leave to each individual the opportunity to enjoy things intellectual and spiritual, as well as physical.

Young gentlemen, I have presented to you a serious problem. You are familiar with the examples and the precepts of the great men who founded and built up this school. You know the truth. Do not be content to go out from here and make use of your knowledge for the benefit of yourselves alone, but in season and out of season, at all times and in all places, be articulate in the defense of efficiency. In time we may turn back the flood which is threatening our civilization and make ourselves what we ought to be: a contented, happy and prosperous nation. Efficiency will then be rewarded by the public's approval, as well as by the usual rewards of financial and social success.

Mr. President, permit me once more to express my thanks for the opportunity which you have given me to renew my belief in the country's future by bringing me in contact with young men like those before me. I shall be glad if I have expressed one thought which may be useful to them hereafter.

PART II

LECTURE NOTES ON SOME OF THE BUSINESS FEATURES OF ENGINEERING PRACTICE

By

Alexander C. Humphreys

IN GENERAL

The lectures, addresses, and papers contained in Part I of these Notes, written by men who have been successful in various walks of life, have shown you what should be demanded of the man who, through a long course of uninterrupted study, has been privileged to prepare himself for specialized service. You have been shown by men who have been keenly sensitive to their own responsibilities how higher education and the capacity for service so cultivated and enlarged necessarily involves a commensurate responsibility to one's fellows; a responsibility which can be neither safely nor happily ignored.

Running through all of these writings you have found a strong current of practicality. You have been reminded constantly that knowledge and capability are to be usefully employed, not selfishly hoarded. Particularly you have had it impressed upon you that, as engineers, you will be required to employ the forces of nature honestly, usefully and economically. This last lesson is of especial value and importance in this country at this time, hampered as we are by amateurs in reform in our struggles for increased efficiency and honesty in business and government in the face of an uninformed and misinformed public opinion.

What you are looking for, we can assume, is real success in your chosen profession. Then certainly it should be of assistance if you can draw upon the experiences of one who probably has had to meet nearly all the difficulties that the majority of you have had and will have to meet, and perhaps some in addition, and is anxious to warn you as far as possible against the errors into which he has fallen.

You should be interested to know what an employer is looking for in the employee. I can give you, in advance of your graduation, information in this direction; and I can give it to you because I was for many years a salaried employee and for many more years a salaried employee while also a large employer

of engineer-assistants and, still later, an independent employer of technical graduates. While, of course, employers are governed by varying ideas in making their selections, I can state to you what I have been in the habit of looking for; and I am inclined to think that to-day, in connection with the keen competition which is now a feature in nearly all lines of industrial work in this country, many employers are guided by the same views.

I would select, first, for honesty, then for thoroughness, and then for energy and earnestness. First of all, I do not want any man in my employ unless he is honest in his intention to work wholly in my interests. Secondly, I do not want him unless he will do thoroughly the work assigned to him, even if the quantity of work is not large. Lastly, if I can get a man who is honest and thorough, and also is endowed with energy and earnestness, in other words, one who has a large capacity for work, I know then that I have a man who will meet all reasonable requirements. Many young fellows, and Stevens Institute men among the number, soon give up the employment which they first secure after graduation because, as they have often expressed it to me, they saw no chance ahead; *whereas the fact is that they had not yet secured a thorough command of the minor details to which they had been assigned.* The young graduate should be very slow to turn away from work to which he is assigned because he sees no advantage to himself in doing that work thoroughly. To him the work seems unimportant, but on this point he is not yet competent to judge. It may be that his employer is primarily or incidentally testing him as to thoroughness; is testing him with what appears to be work of little responsibility. The man who performs any duty, no matter how humble, anything less than thoroughly has no right to expect promotion. The employer who would promote such an employee does not deserve loyal service.

I told last year's class of a case which had just been called to my attention. Three young graduates were employed by a certain industrial concern and put to work at all sorts of rough detail work. They were well paid. One man resigned in a month

or two because he said it was not work suited to the capacity of a man who had received a technical education; the second man stuck to it for a year or so, grumbling much of the time; the third man went ahead uncomplainingly, performing thoroughly and promptly every task to which he was assigned. This third man was transferred from one rough job to another for three years. Then the manager sent for him, reminded him that his two companions had left, one after a very few months, the other after twelve months. He then asked this third man what had led him to go on with the work assigned to him. The young man replied something to the effect that he was perfectly satisfied with the fact that he was day by day gaining experience, that he was day by day finding something to learn, and that he was confident from what he saw of the management that there would be a place for him if he could prove that he was competent to fill some one of the more important positions. The manager then told him that his services were satisfactory, that he would now be pushed forward to higher positions, and at the end of two more years he would be placed in a position of authority and responsibility if he continued as he had begun. The result was that at the end of the five years this young man was drawing a salary of $5,000 a year, this salary being warranted by the fact that he was competent *and in sympathy with the company's scheme of management.*

There are some who are perfectly willing to do the work assigned to them and do it thoroughly, but who do not go beyond this in seeking for opportunities to take on additional work or to further cultivate their powers in the school of experience. These men, lacking in ambition, initiative, or in robustness of mind or body or both, will probably continue to fill minor positions. But their lives are successful as compared with the lives of those who have the desire and push to go higher but are not willing to perform the necessary preliminary drudgery.

I am continually brought in contact with men who attempt to justify their incapacity by claiming that they are men of breadth; that they employ narrow men to do their detail work.

The fact is, probably, that they have no real capacity except to steal the product of other men's brains.

Do not misunderstand me. I am not advising you to be narrow men as opposed to broad men. Broaden your capacity for service as fast as you can. The men who do each piece of work thoroughly *and then try to learn how to do something else just as thoroughly will gain in breadth.* The narrow man is the man who is satisfied with thorough performance in one narrow line of effort.

There are many men of breadth who do employ men to do special work for them, work which perhaps their employers could not do as well for themselves; but, almost without exception, these men are masters of detail in *some* lines and so govern themselves by an appreciation of the necessity for accuracy and completeness of detail in all lines.

I have more than once had Napoleon quoted to me as the personification of breadth; I then quote him back as the master of detail, not only in one department of army administration, but in every department. He knew what could be accomplished and the best means to adopt therefor, and knew what he had the right to demand from his subordinates.

The fact that there are superficial men who flatter themselves that they are broad, and who succeed in making money through reckless push, should not encourage us to believe that it is not desirable for a conscientious man to pass through the drudgery of the training period. For one of the former type who succeeds there are hundreds who can be found sliding more and more rapidly down hill, perhaps starting from watching the "ticker" in a broker's office and winding up as the shabby-genteel tramp, or worse.

The privates in the army of promoters are largely of this class, and many of these who succeed as money makers do so because they are willing to risk the money of their friends and dupes.

The cry to-day in the industries is for efficiency. Then this presents the opportunity for the engineer who has been trained to strive for the highest attainable efficiency in his applications

of science to the practical things of life; and here commercial limitations and conditions must be kept in view continually.

Believe me when I say that employers find it quite as difficult to secure competent employees, as men out of position find it difficult to secure satisfactory employment. Intelligent employers are constantly on the watch for their young employees to betray their inner selves. The employee may be doing some very simple work, but if the intelligent employer sees that the work is being done thoroughly and with energy, the chances are that he will make a mental note that this man is capable of doing something larger.

Young men who wish to secure remunerative and developing employment must be willing to go where that employment calls them. Those who insist upon being located in the vicinity of New York—for instance—must be willing to recognize that their chances are accordingly limited.

One of the great troubles with young men—and older men too—is that they do not complete their work. When they meet with a problem which they cannot see at once how to solve they fall back on the man above to make good their deficiency, not recognizing that it is their duty to go ahead and do the best they can and *go as far as they can without assistance.* Let me quote from Mr. Kerr's admirable address to the last graduating class: "This is about the time to show your nerve. Don't be dazed or baffled, but make a start. Use your wits and you will get somewhere, and if you cannot always see the end it will constantly get nearer and plainer *when you go as far as you can and then see how far you can go.*"

A friend of mine last summer had an experience in this direction. He was engaged in a most important piece of work. His strength was greatly reduced by ill health and he was anxious to tax his strength as little as possible, and therefore to do little more than direct the work of others. But he found that his chief difficulty was to get any one employee to finish up any one piece of assigned work. After working four or five months on this case, he told me that there was only one man of the number who had completed any one piece of work assigned

to him, and the result was that his health was again broken down by the work entailed in making good the deficiencies of those who were paid to do the work; and these men were specialists in the lines for which they were employed. In such surroundings see how the thorough man comes to the front.

Let me give you an example from my own experience. It has to do with a day laborer, but the principle is the same. Years ago I had undertaken to push through a piece of outside work which had to be completed within a given time or the result would be a considerable loss to my company. My directors were reluctant to have me undertake the work, feeling certain that it could not be completed within the time limit. I took on a large force and organized it in squads for different classes of work. One part of the work, and a very important one, was to fill in the excavations as fast as the work under the surface had been completed. After a day or two, I noticed that a young Scotchman, only recently landed and quite green at the work, was the only one who could be relied on completely to follow my instructions in this class of work. The work to be done was easy to understand; the trouble was that there was so much monotony connected with it that the majority of the men would neglect it unless constantly supervised. I soon found that, whether I was looking on or whether I was in some other part of the field, this man's work was not neglected. After a few days I took him to one side, told him that I was satisfied with his work and asked whether I could rely on him to boss a small gang if I placed that department of the work in his hands. I agreed to back him up if he would pledge himself to inform me if the men neglected their work or disputed his authority. He expressed confidence in his ability to satisfy me, and I placed him in charge as a sub-foreman. The result was that that part of the work was done thoroughly and *never gave after trouble.* The outcome was that this man, instead of being laid off at the end of this particular job, as the other laborers were, was taken into the works and given steady employment at an increase in wages of 33 per cent. He was then given an opportunity to learn the

details inside the works and secured employment for life at good wages.

I quite appreciate that some of these arguments in favor of thoroughness do not appeal to the highest motives. But there is nothing wrong in a man trying to advance his interests and it is his duty to make himself so competent that he will never be a charge on his friends or society. A duty well performed from lower motives frequently leads to the development of higher motives.

A number of times recently I have had drawn to my attention the fact that young engineer-students do not really appreciate what their technical education is doing for them. For instance, in a recent interview with a man who graduated last year, I was informed that he had learned more in three months, running a small plant and being made responsible for the care of the plant, than he had learned during the four years at Stevens Institute. This is a sample of many cases of a like nature which I have had forced upon my attention. This young man failed to see that it was largely because of his training at Stevens Institute that he was able to learn so quickly how to run this plant. It was his training at "Stevens" which had qualified him to make this rapid progress in the school of experience. Without this preliminary training he might never have been able to learn what he had thus learned in three months.

This lack of appreciation for the part which the college training plays in a man's after life, and especially his success, is not by any means confined to the technical graduate. We frequently hear men say that they are unable to put their fingers upon any one thing for which they can thank their college training. No doubt this is true, in a measure, with many men who neglect their opportunities; but the man who is so inclined to question the value of a college training should bear in mind that it is not the facts stored up which are of so much value, but rather it is the capacity for straight thinking and reasoning which has been cultivated in college. The technical graduate especially should have this point in mind when he is inclined, in his pessimistic moods, to feel that he has wasted the

four years devoted to technical study. Even the man who takes up employment in a branch of engineering which has not been covered specifically by his college course will find upon consideration, if he has any powers of analysis, that it is the preliminary and fundamental training in science and mathematics which has qualified him to take up, with confidence as to his ultimate success, his particular specialty. And this brings me to another point which is frequently urged against the value of a college training, and very often urged against the value of a technical training.

You hear it said that men of high scholarship often do not succeed in life. It is true that men who have gone high in scholarship frequently are not successful in practice. This is because they have failed to learn in the school of experience; for, as I have said, you must bear in mind that the work in the school of engineering must be supplemented by equally conscientious work in the school of experience. To graduate at "Stevens," a man must pass at least 60 per cent in every study. If our 60 per cent men succeed in after life, as compared with those of a higher grade of scholarship, it is because by natural bent and the exercise of common sense and industry they take better advantage of the opportunities for training afforded by the school of experience, and so they secure in that school such a high grade that, averaged with their low grade of 60 per cent in the technical school, their general average is still satisfactory. Whereas, if the technical graduate who has secured a 90 per cent average in the school of technology, through one cause or another neglects to pursue his studies in the school of experience, and so fails even to get a passing mark in that school, his general average will still be low as compared with that of the man who secured a 60 per cent grade in the college and a 90 per cent grade in the school of experience. This does not apply in the same degree to the men who graduate from an institution like Oxford and then continue to work in some of the fields of higher scholarship. Naturally, then, the high grade obtained in the college qualifies them for their life's work.

As I am trying constantly to show you men, the technical education that you get in a school of technology must be supplemented by the training that you will receive in the school of experience. The industrial manager of to-day must be a man who has had the opportunity in both schools and has taken full advantage of all his opportunities. In this connection, let me refer to a point which I have had forced on my attention a number of times since I have been president of the Institute. As you know, we are in the habit of calling in engineers from outside to lecture to our upper classes on some special features in engineering practice. We frequently call in our own graduates who have won success. I have listened to a number of these lectures given by men who are essentially engineers; that is, they are responsible more particularly for the strictly engineering side of their business than for the commercial side. Still I have noticed and drawn to their attention, and received their acknowledgment of the truth of my observations, that one-half to two-thirds of each lecture is devoted to the practical features of their work, and especially to the questions of commercial limitations under which they have been called upon to operate.

To meet all the responsibilities which have been so placed before you, you must be willing and ready to undertake and persist in certain studies which may not at first appeal to you as necessarily included in the study of engineering science. If these studies at first impress you as unnecessary drudgery, let me remind you once more that no effort to acquire a command of fundamentals either in theory or practice is unimportant, and the man who neglects the fundamentals and small things —as he considers them—as unworthy of the attention of one so talented, lives to learn that the world rewards him who concerns himself actively and efficiently with the present task.

It falls to my lot to make the effort to give you within very limited compass some insight into certain features of engineering practice which, while all-important, have not generally received sufficient attention in our colleges of engineering. Particularly is it my purpose to attempt to connect engineering

practice, as generally understood, with commercial practice. If you are not already convinced, I shall expect to convince you that engineering enters into all the industries and all branches of commerce.

Then we are at once concerned with one art or science which has to do with the recording of the financial results obtained from all human activities. This art, being universal, makes it important, if not actually necessary, that the engineer should at least be familiar with its principles and should have a working knowledge of the methods employed in practicing the art.

I refer to what you have generally heard spoken of as bookkeeping; but we shall learn later to differentiate between the art of accountancy and the bookkeeping methods employed therein.

Before some of the matters to be covered in this course can be considered profitably, an understanding must be had of the principles of accountancy. In fact, many of the most important questions now pressing for solution and in connection with which engineers are depended upon for expert advice, cannot be intelligently or intelligibly discussed without this knowledge.

In each of my classes, I have found that certain of the students have already received instruction, more or less complete, in bookkeeping. I am always glad to find that there are some of our students who have had this advantage; but let me say to such that they can still well afford to give close attention to this subject as developed in this department. They should be able to get more from this part of the course than can those who have previously had no instruction in this line; for they are better prepared to digest the matters placed before them and they should be more keen in their appreciation of the value of such instruction. This appreciation should increase more and more as knowledge is gained in the school of experience. The value to the individual of advanced instruction depends in large measure upon how completely the mind has been prepared by previous elementary instruction and experience.

But apart from all of this, you will find that I am covering in these particular lectures much that is outside of bookkeep-

ing and accounting and much which the bookkeeper and even the accountant, through lack of special training, would not be competent to give you. As a warning, I may say that in my previous classes I have found that some of the men who had received instruction in bookkeeping before coming to the Institute made a poorer showing in the examinations than those who had not had this previous advantage. Probably this was because they thought that they were already so fully informed that it was not necessary for them to make any effort to follow the subject with me.

Always remember that the engineer is not so much a scientist as a man who usefully applies by the most practical, efficient, and economical methods the truths of science.

Therefore, to give your technical studies their full value after graduation, you must be prepared to acquire quickly in the school of experience the ability to apply practically, efficiently, and economically your theoretical knowledge in accordance with the legitimate demands of the business world.

It is to prepare you in some measure to meet these demands that I have undertaken to direct this department.

ACCOUNTANCY

General Principles

In the reprints of lectures, magazine articles, and addresses which you have been required to read and in my preceding lectures, you have been furnished with sufficient reason for my claim that the engineer should be prepared to practice his profession within the limits set by commercial conditions, and that also the engineer should be familiar with business methods and practice. Especially, he should know the language of business; namely, the language of accountancy. Without familiarity with this language the engineer is unable to read, except through an interpreter, the statements that give the final result of the enterprises in which he is engaged: or, in other words, he must take on faith any and every statement which his and other men's bookkeepers and accountants make to him. For a simple example let me refer to Mr. Turnbull's lecture where he says:

"We will suppose that we are doing a simple merchandise business, buying and selling. We shall have *charged* all our *purchases* to merchandise account, and we shall have *credited* all our *sales* to merchandise account. We will assume that our *purchases* have amounted to $100,000, and our *sales* to $90,000, but we find upon taking an inventory that we have goods on hand worth $25,000. Now, if we add the $25,000 to the $90,000 at credit of merchandise account, we have $115,000 as against a cost of $100,000. It is evident to you, therefore, that we must have made $15,000 profit. But to arrive at that in bookkeeping fashion, we debit merchandise account with $15,000 profit, and credit profit and loss account, bringing down a balance to the new merchandise account of $25,000, being the $10,000 balance already at the debit plus the $15,000 profit charged, making $25,000 as the value of merchandise and the debit to merchandise account with which to commence the new fiscal period. Now we find that we have $15,000 to the credit of profit and loss, but we have various expense and other debit accounts affecting the result of the business, and we debit profit and loss and credit these various accounts with their respective amounts (we may have also credit balances to other accounts, such as interest—affecting the result, and these we credit to profit and loss), and assuming that as a net result of the various debits and credits to profit and loss we have a balance of $10,000, this then is the net gain for the year, and we transfer it to our individual account by debiting profit and loss and crediting our account."

I have found with some of my classes that this statement as written could not be followed by a majority of the students. I am certainly warranted in believing that the members of our senior classes (having been subjected to the "weeding-out" process for three years) are above the average in intelligence and ability to follow out a more or less abstruse proposition, and yet they experienced difficulty with this simple proposition. The trouble, then, is unquestionably in the fact that the students do not understand the language in which the statement is made. Part of Mr. Turnbull's statement is made in the language of everyday life and part in the language of the accountant.

Now, let me make this same statement, employing only the language of everyday life, and there is not a member of the class who cannot follow me.

Jones engages in a simple merchandise business, buying and selling. He purchases merchandise which costs him $100,000. Three quarters of that merchandise, or what has cost him $75,000, he sells during the year for $90,000. The expenses for operating the business for the year amount to $5,000. He has, therefore, made a gross profit on his sales of $15,000, and it has cost him $5,000 to carry on the business in connection with those sales, leaving him a net profit of $10,000. As this gross profit of $15,000 was made on the sale of only $75,000 worth of his merchandise, he still has $25,000 worth on hand, subject to sale; and this fact should show on his books.

The statement as thus made a schoolboy can follow. But here it is to be borne in mind that in business we must have a method of recording our results which is *concise and based upon principles capable of universal application.* If the engineer—and especially the engineer who engages in industrial management—expects to be able to read the systematized records of business results without depending upon outside interpretation, he must, then, as I have said, be able to read with some facility in the language of accountancy. In the example that I have given from Mr. Turnbull's lecture (and it is an extremely simple example and selected by him for that reason) we have

shown that the statement could not be followed by a majority of the members of our senior classes without additional explanation or interpretation. But it is to be borne in mind that that statement is made only in part in the language of accountancy. We may assume, then, that if it had been made *entirely* in the language of accountancy it would have been absolutely unintelligible to those who had not already had experience in accounting.

I think, then, that this presentation of the subject, in connection with the facts and arguments which already have been advanced, should convince you that a knowledge of accounting is not only important but necessary to the engineer who aims to fill satisfactorily any managerial position. Now, I do not expect to be able to make bookkeepers of our students. This is not necessary, nor is it even desirable. I only aim to give them such a knowledge of the principles of double-entry bookkeeping that they will be able to read without assistance the record of results, for it must be borne in mind that unless, by detailed analysis of the statements of account, you are able to detect inefficient and uneconomical items in the management, you are certainly unable to introduce the necessary corrections. A competent analysis of accounts is at the very foundation of efficient and economical management.

The bookkeeper should be trained to do the actual work of bookkeeping correctly, neatly, and rapidly. He may be competent as a bookkeeper, but not competent as an accountant. That is, he may be able, with accuracy and rapidity, to follow the lines laid out for him by the accountant, but he may not have such an understanding of the principles of accountancy and the details of the business as will enable him to lay out for himself the system of accounts.

It is quite possible for the members of this class to obtain such a knowledge of the principles of accountancy that they can direct such an expert bookkeeper as to the proper methods to be followed, without having that expert bookkeeper's facility in the actual performance of the work.

I have been told more than once by young men who have taken courses in bookkeeping in commercial colleges that they

regarded it as time wasted, because the bookkeeping methods followed in different establishments so varied that very likely after having learned certain methods in the commercial college they would be required to take a position where these methods had no place. If this is a fair statement of what is done in some of the commercial colleges, it simply goes to show that those colleges teach methods and not principles. I am reluctant to believe that this is true. It is true that the methods followed in different business establishments vary to a great extent. The methods followed generally in America are different in part from those followed on the Continent of Europe. But the same general principles are included in all systems of double-entry bookkeeping, and if our students get a firm hold on those principles they can, *with some little effort,* analyse the statements prepared from any well-kept set of double-entry books. It may be necessary to have the details of accounts, and the like, explained, but such explanations can generally be obtained when necessary.

Many authors of text-books on bookkeeping and accountancy make little effort to explain principles. Some set out certain definite rules to be memorized and expect that the students, when they have to decide some questions as to principle or method, can select the right rule and apply it properly. This may work satisfactorily for bookkeepers, but certainly it cannot work satisfactorily for accountants, and especially would it be unsatisfactory in the case of men like yourselves, who probably will be called upon in this connection to deal with principles only.

Here it is to be noted that some of the text-books on bookkeeping which fail to teach principles are particularly strong on methods. It is quite possible that some of you, who might be assisting the bookkeeping department of some concern to record fully and correctly the results of an industrial business, might find it of distinct advantage to refer to some of these authorities, who are sometimes able to suggest legitimate shortcuts for the reduction of clerical labor. If the engineer-student had previously obtained a fairly good grasp of the principles, he

might, working in coöperation with a good bookkeeper, be of great assistance in utilizing and developing efficient methods of cost keeping and accounting.

I have referred to the double-entry system, or the Italian system, as it is sometimes called. Mr. Turnbull in his lecture has shown that there are two systems, the single-entry and the double-entry systems. The single-entry system does not especially interest us, because it is employed by retail concerns only; or, perhaps, to be more accurate, it should be employed in such cases only. As will appear later, the single-entry system does not afford any check as to the correctness of the transactions recorded, whereas the double-entry system does afford as complete a check as can be devised.

There is often some misunderstanding as to the meaning of double-entry in this connection. Let me say at once that it does not mean that for every entry made by the single-entry system, there are two entries made by the double-entry system. It does mean, however, that in every transaction the amounts involved appear upon both sides of the final book of record.

To understand this a little better, let us go back. Every time that Jones made a purchase of merchandise in accumulating his $100,000 worth of merchandise stock, the man from whom he purchased made a sale; and every time that Jones made a sale of part of that merchandise, the man to whom he sold it made a purchase: that is, for every sale there was a purchase and for every purchase there was a sale. Or, for every credit there was a debit and for every debit there was a credit. And this is true even though each of these credits and each of these debits do not appear separately on the books of account. As you will see later, by the time the transactions are finally recorded on the ledger many credits and many debits may have been consolidated; but the fact remains that *each side of each transaction will in time find its place in the final record.* You know the old saying, that it takes two to make a bargain.

Then, in the double-entry system, in every transaction, in one way or another, both the credit and the debit sides of the transaction are recorded. If Jones buys from Robinson $100

worth of merchandise, Robinson sells to Jones $100 worth of merchandise, and if both sides of the transaction are recorded, $100 appears on each side of the final book of record, namely the ledger, and these two amounts balance each other; and this is true with all transactions. Hence in this final book of record, if the books have been correctly kept and we draw off a statement showing the debit or credit balance of each account, we will find the sum of the credit balances equal to the sum of the debit balances; or, if, as some bookkeepers do, instead of, or in addition to, taking the balances, we take the debit and credit footings of each account, the sum of all the credit footings will equal the sum of all the debit footings. If such a balance is not obtained, namely, if there is a difference between the sum of the debit balances and the sum of the credit balances or between the sum of the debit items and the sum of the credit items, we know that some mistake has crept into the work. Then the error or errors must be located and corrected before further progress can be made.

While it is true that notwithstanding the check obtained through this balancing of credits and debits against each other, errors may creep in because two errors of a like amount may be made which will balance each other, or an amount which should be entered in one account may be entered in the *correct* side of another account, still, this does not disqualify the double-entry system, for after years and years of experience it has been found to afford as complete a system of checks as it has been so far possible to devise.

I have spoken of the book of final record as the ledger. It might perhaps seem more in order if we first took up the primary records and then went on to the final record; but the result we are looking for is to be found in the ledger. Therefore, I will first consider the result and then work back to the means employed to obtain the result.

If a member of this class were treasurer of the Athletic Association and had occasion to distribute against the several athletic teams certain items of expense, he might perhaps take a sheet of paper and put down headings to designate the several

teams. As each item was analysed he might determine what per cent thereof was to be charged against each team. Having determined the per cent he would figure out and put under the proper heading the amount so found. He would do this for each item to be distributed. Having finished this work of distribution or *classification,* he would foot up the amounts in each column and then, to check up as to the correctness of his work, he would see if the sum total of these several amounts as distributed against the several teams, equaled the sum total of the items distributed. The several items expended by the treasurer for the benefit of the several teams would be to his credit and to the debit of the respective teams. Then the sum of the debits, as distributed against the several teams, must equal the sum of the items on the treasurer's memorandum of items, to his credit. In a simple case of this kind probably the actual necessity would be met by such a method carried out on a loose sheet of paper, though it would be then necessary to make some final record in case some question might arise in the future. But in a business of any size, the amounts of money which are spent and the amounts of money which are received, and all transactions in which no money actually passes, have to be recorded in permanent form and by such a system that at any time in the future the facts can be shown fully at a moment's notice. If a man is owing us money and from time to time he is making payments thereon and is making further purchases from us, we must have one place where these several transactions can be summarized. That is, we must keep an account with him. Or, to speak in a more general way, to analyse the results of our business, we must be prepared to determine what the different branches of our operations have cost us, what the different branches have returned to us in income, and what has been the final result either in profit or in loss. It will be necessary, then, to classify these different items under proper headings, these headings or titles of accounts to be self-explanatory as far as possible. These accounts must be so kept as to lend themselves most completely to analysis. The

book in which the facts are so summarized, classified, and stored is called the ledger.

In the double-entry system all debit entries are carried into the left dollars-and-cents columns and all credit entries into the right dollars-and-cents columns. This is the case with the ledger and all the other regular books of account. Sometimes, as in the ledger, this separation is accomplished by dividing each page into a debit and a credit side by a vertical ruling through the center of the page. Sometimes, as in the cash-book, the two pages which open opposite to each other are employed as a couple, the left page for debit items and the right page for credit items. Sometimes, as in the journal, the debit and credit dollars-and-cents columns are side by side at the right side of each single page, the debit column, however, being to the left of the credit column. No matter what may be the special ruling employed, the credit column is always to the right of the debit column. This is an arbitrary arrangement. If it had been decided originally to carry the debit items to the right side, and the credit items to the left side, the accounts could have been kept just as accurately; but it is at once apparent that for general convenience there should be, the world over, a uniform practice in this regard. Fortunately, then, this arrangement obtains the world over.

But here comes in a point that is a frequent cause of confusion, especially in the mind of the man not familiar with accounts. Suppose I am keeping an account with a man: If I make out a statement of that account from my standpoint, that is, from my side of the transactions, the amounts which I have paid to him will appear on the credit side of my statement, and the amounts which he has paid to me will appear on the debit side of my statement. But, suppose that he, from his books, renders the statement of account to me, then the statement is prepared from his standpoint, and while the two statements may be correct and identical in every particular, not varying to the extent of one cent, still every item which on my statement of account appears on the debit side will, on his statement of account, appear on the credit side, and vice versa. Unfortu-

nately, it is not always apparent from the heading of the statement from which side of the transaction the statement has been made. The parties directly concerned have their special knowledge to guide them as to the facts, but others who may be interested may be unable to read the statement. It is in such matters as this that the European accountants are inclined to be more uniform and precise in their practice than those of America.

To repeat, every item involved in our several transactions finally must be recorded in the ledger, and, if the record has been correctly kept, the sum of the items on the debit, or left, side will equal the sum of the items on the credit, or right, side, and unless they do so balance we must accept the fact that at least one error has been made which must be found and corrected.

Before passing on, let me urge you to consider carefully the point above made as to the reversal of the debit and credit items on the two sets of books as kept by the two parties to any one transaction. It is necessary to appreciate fully this point to understand why a ledger balances, and why in posting from the cash-book to the ledger, as later to be explained, the items on the left (debit) side of the cash-book are posted on the right(credit) side of the ledger, and the items on the right side of the cash-book are posted on the left side of the ledger.

We now come to the questions: How are these items obtained for the ledger? What is the basis for this summarized final record?

The system of primary records which forms the basis for the ledger entries varies very considerably, but in general we may say that the three main books of account are the cash-book, the journal, and the ledger. Under the head of the journal can be included certain subsidiary books, which perform certain parts of the journal's duty.

Let us first consider the cash-book. Keeping track of our cash expenditures and cash receipts is, of course, of primary importance. Therefore, we are warranted in maintaining a special book for this purpose which will contain the facts in

regard to each transaction in some degree of detail. In the cash-book each left-hand page is for debit entries and each right-hand page is for credit entries. *All items are entered in chronological order. The debit and credit entries of even date are made on the pages opposite to each other.* If there are more entries of a certain date on one side than on the other, and so one page is filled up while the opposite page is only partly filled, the blank spaces are not filled, and the next two pages are opened with entries of even date. The reason for using a full page for debits and a full page for credits instead of dividing a single page into debit and credit sides, is because there should be sufficient room to make each entry in detail and it is desirable that the record should occupy only a single line.

Let us first think of what is meant by cash account. It is an account kept with *ourselves.* If there were only one owner of the business, then cash would really represent that owner. But, even then, cash would have an identity of its own as will be seen later. Suppose there are two partners to the business and each puts into the business $5,000 as capital. Then, certainly, when that money is put into the business for the benefit of both, each man should be credited individually with $5,000. The business as a whole should credit each man with $5,000 and, therefore, the business as a whole should be debited with each $5,000 received. In the cash-book, which represents the business as a whole, these entries should appear on the debit side. When cash receives money, that is, when the business receives money, it must debit itself with that receipt. On the other hand, when, in the course of business, cash pays out money, cash account must be credited.

When we receive we become the debtor to the one who gives.
When we give we become the creditor to the one who receives.

Even in the case of a business which is owned and controlled by a single proprietor, the owner of the business may be concerned in many other enterprises, but his relation to this particular business must be clearly shown in the books of this concern. Cash account has been made the custodian of this part of his money, and, therefore, cash account must be debited

and the proprietor *as an individual* is credited through an account which may be called capital account. This is more readily apprehended in the case of a stock company in which the capital is supplied by many individuals in widely varying amounts. Here it is evident that the business as a whole must account to each individual stockholder for the capital he has invested with the concern. The business as a whole has received the money and placed it in the cash account and hence the cash account is to be debited and the individual stockholder is to be credited. This credit to the stockholders is generally shown in a general account called "Capital Stock," or "Common Capital Stock," or "Preferred Capital Stock," as may be necessary to indicate the character of the participation in ownership. The individual holdings are certified to by stock certificates issued to each stockholder. As these stock certificates are issued, credit is given on a capital stock ledger or record; and as the certificates are cancelled, owing to transfer of ownership, the proper individual accounts are debited, and the accounts of the new owners credited for the new certificates issued in exchange and at the same time the surrendered certificates are cancelled. This is a case of a supplementary or individual ledger in which are given the details as to *individual* debits and credits, the general conditions only being shown on the general ledger. It should be unnecessary to point out that the sum of all the credit balances shown by the individual ledger should correspond exactly with the credit balance of the one capital account in the general ledger. The latter shows the amount of capital which the concern has to account for (is liable for), and the first shows who are the individuals who own the stock and to whom the company is liable.

Then it can be seen that capital account in any of these cases should be credited with the capital invested in the business; that capital as received will be recorded in the cash-book, and as it is received by cash, cash should be debited; that capital (collectively and individually) should be credited. How is this part of the record made?

The entry on the cash-book is made on the left or debit

side, and shows that cash is debited, as it should be. But the descriptive matter of the entry also shows from whom the money is received and why it is received, *and therefore without any additional entry it shows to what account and to whom it should be credited.* So we find that the one entry on the debit side of the cash-book also records the *credit* side of the transaction. This is an important point and must be fully comprehended.

Now let us follow through in detail the entries covering one of the payments made to cash on account of capital. We will assume that we have to do with a stock company; the shares being $100 each and issued at par.

John Smith subscribes for 100 shares, for which he pays $10,000. The entry is made on the debit (left) side of the cash-book;—first the date received, then the title of the account (Capital), then the name of the man from whom it is received (John Smith), and then the amount ($10,000). In due time a stock certificate will be issued to Smith, and on the stock ledger he will be *credited* with the ownership of 100 shares of stock, the record including the detail as to the number of certificates issued, the number of shares covered by each certificate, and the serial numbers of the certificates. Probably a single certificate of 100 shares would be issued and the record would be so made, showing the serial number of the certificate for identification. This takes care of the liability to the *individual.*

When the other cash-book entries are being "posted" into the ledger, from the debit entry on the cash-book (that is, debit to cash because cash has received the $10,000), capital account in the general ledger will be credited with $10,000.

So we see that in posting from the cash-book to the ledger we post a debit entry in cash to the credit side of some account in the ledger. And this reversal in the posting is due to the fact that we are taking note of both sides of the transaction. If cash is debited for money received from John Smith on capital account, capital account must be credited, and we must also record the fact that John Smith is the individual to whom the business is responsible for that part of the capital. We have now seen that capital account is credited on the general ledger,

and John Smith, the individual, is credited on the subsidiary book called the stock ledger.

This posting of the credit in the two ledgers does not constitute two credits against a single debit as has been suggested by some of the students, because it is the general ledger which shows the liability *as a whole* and the stock ledger shows only how this liability is apportioned. The stock ledger simply shows the details in connection with the more general record in the general ledger.

But now it may be said, There is no double entry in the general ledger; there is a debit to cash which is recorded on the debit side of the cash-book and this debit has served as the basis for posting $10,000 to the *credit* of capital account in the general ledger, but there is no debit entry in the ledger to balance this credit entry to capital.

To this objection I reply that in the general ledger, there is kept, *or there should be kept,* a cash account. This account will represent cash's side of each transaction; that is, the opposite side to that represented by capital account (or John Smith's capital account, if we kept all the individual capital accounts in the general ledger instead of only summarizing them under the general heading of capital account). Having posted the $10,000 entry from the debit side of the cash-book to the credit side of the capital account in the ledger, it now remains to post the entry into cash account in the ledger. But as this cash account represents the same side of the transaction as that represented in the cash-book, we post from the *debit* side of the cash-book to the debit side of cash account in the ledger. But as *all* the entries on the debit side of the cash-book must be posted into the cash account in the ledger on the debit side of that account and all the credit entries of the cash-book into the credit side of the cash account in the ledger, we may as well wait until a number of them have accumulated and post them as a sum into the ledger. The general custom is to "close" the cash-book once a month. During the month the individual items have been posted from the cash-book to the ledger, item by item, to the several accounts involved, *the debit items to the credit side of these ledger accounts*

and the credit items to the debit side of these ledger accounts. Thus we have classified or distributed the several cash debits and credits to the credit or debit of the respective accounts opposed to cash in the several transactions of the month. Now we post the total footing of all the entries appearing in the debit columns of the cash-book to the debit of cash account in the ledger, and we post the total footing of all the entries appearing in the credit columns of the cash-book to the credit of cash account in the ledger. So we have, item by item, all the debit entries in the cash-book distributed and posted to the credit side of the several accounts in the ledger; and, item by item, all the credit entries distributed and posted to the debit side of the several accounts in the ledger; and all the debit entries of the month posted in *one* amount to the debit side of cash account in the ledger, and all the credit entries of the month posted in *one* amount to the credit side of cash account in the ledger. So every entry in the cash-book has been posted on both sides of the ledger; for every debit there has been a credit and for every credit there has been a debit, and so as far as cash items are concerned the balance in the ledger between debits and credits is maintained.

Day by day, as the cash transactions are completed, that is, the money is received and the money is paid out, each transaction is entered up separately on the cash-book. Cash received is entered on the left page, namely the debit page, and cash paid out is entered on the right page, namely the credit page. The fact that debit entries are made to the left and credit entries to the right must be memorized, for, as I have said, it does not depend upon principle; it is an arbitrary arrangement, fortunately accepted by all, so that uniformity of practice throughout the business world is secured.

Take another item:—We pay out money for the salary of the bookkeeper during the first month. That amount, being paid out by cash, must be credited to cash; that is, "Cash" has accounted to that extent for the money entrusted to it. But it must be charged against either the individual or some account which keeps track of this part of our year's expenses,

say salary account, or expense account, according to how we classify this item of expense. Again you see that what is written up as a credit on the right side of the cash-book is posted as a single debit to salary account in the ledger; at the end of the month, the total footing of the cash credit columns will be posted to the credit of cash account in the ledger and this item of cash paid to the bookkeeper will be included in this total. So we have all the credit items on the cash-book classified and distributed throughout the ledger on the debit side of the accounts concerned and all these cash credit items posted in bulk in the ledger on the credit side of cash account.

Of course, there should be no reversal of the posting from the cash-book to cash account, because cash account in the ledger means exactly the same as in the cash-book; that is, we are considering the same side of the transaction in the ledger that we have considered in making the cash-book entries. From each side of the cash-book we have posted into the ledger the *implied* side of each transaction, item by item, from the debit side of cash-book to credit side of ledger, and from credit side of cash-book to debit side of ledger. We have later posted to the same side of the ledger as that in which the items appear in the cash-book, the total of these items, and so we have on the ledger for every debit a credit and for every credit a debit. We find them in one case in bulk and in the other case itemized. That is, those amounts which have been posted from the *debit* side of the cash-book and so appear item by item on the *credit* side of the several involved accounts in the ledger, also appear as a single amount on the *debit* side of cash account in the ledger. And so the ledger accounts, as far as cash items are concerned, are kept in balance.

I have written this at great length and repeated myself advisedly, for I have found in my classes that the students seem to have great difficulty in understanding the reason for this reversal in the posting from the cash-book to the ledger. Until they do fully comprehend this point, they fail to understand the underlying principle of double-entry bookkeeping.

ACCOUNTANCY

Methods

In this second lecture on accountancy I shall deal more particularly with methods, but in my desire to enforce a right understanding of principles, I shall not hesitate to repeat myself.

As is my practice, I shall here try to answer questions which have been suggested by my previous talks, and I shall have no regrets if I set your minds working on still other more advanced questions.

Let me first repeat that I am not trying to make bookkeepers of you but to give you the opportunity to acquire a knowledge of the principles of accountancy.

Some of you have been puzzled at the distinction I have drawn between the accountant and the bookkeeper.

To be an efficient bookkeeper a man should be a good penman, writing a neat and legible hand, and preferably writing with some degree of rapidity. He should be able to add long columns of figures accurately and rapidly, and preferably more than one column at a time. He should be able to add a vertical column of figures with the same accuracy and rapidity, whether adding up or down; and he should have equal facility with a horizontal column, whether adding from left to right or right to left. He should be able to subtract accurately and rapidly. He should have the ability and temperament to enable him to concentrate his mental processes continuously for many hours upon details, so that he will not be liable to make mistakes due to absent-mindedness, such as reading 657 and writing down therefor 756. He should have a certain sharpness and alertness of mind to enable him to determine quickly where to look for the most probable sources of error when his accounts refuse to balance. It will also be a great advantage if he has the capacity to originate labor-saving bookkeeping methods specially applicable to the business in hand. If the man is big enough, the bookkeeper can develop into the accountant.

To be capable as an accountant, much of this skill of hand and readiness of performance is not actually necessary. *The accountant must be able to direct the bookkeeper.* Therefore, he should have a complete knowledge of the principles of accountancy and a sufficient knowledge of business methods and practice in general to qualify him to apply these principles to the requirements of any particular business. He should be able to recognize where his special training and knowledge should be supplemented by the special training and knowledge of those skilled in the technical details of the business. He should be competent to originate such a system of reports as will place before the management, comprehensively and in detail, the results obtained from the business. Thus it is seen that the accountant must be much more than a bookkeeper.

It is true that most expert accountants are or *have been* expert bookkeepers. Through lack of practice in the actual keeping of books they may have lost some of the manual and mental dexterity required to perform accurately and quickly, but the training so gained is a necessary qualification in originating methods to meet varying requirements through the application of the same principles, and in the reading and understanding of books and accounts wherein the same principles have been applied by means of widely varying methods.

We may, then, in some degree liken the distinction between the bookkeeper and the accountant to the distinction between the mechanic and the engineer.

Here at "Stevens," in training you to be engineers, we put you through a limited drill in the shops, not with the idea that we can, during the time at our disposal, qualify you as mechanics, but that we can give you some appreciation of the principles involved in efficient shop practice, and of how the engineer's designs are realized in the shop. And in this connection you are shown in principle, if not in detail, that the engineer must modify his designs to conform to efficient and economical shop practice.

If before coming to "Stevens" the student has "served his time" as a mechanic, so much the better if he also has the mentality and determination to be something more than a mechanic.

Thus with this course in the principles of accountancy, it is better if the students have had some training in bookkeeping; such training is not, however, necessary and is a handicap if it leads them to depend upon their acquired knowledge of *methods* and so neglect this instruction in *principles.*

Coming now to a consideration of some of the bookkeeping methods employed to meet the requirements of accountancy, we see at once that these methods must provide a correct and permanent record of all transactions in which money or the equivalent has been exchanged.

The scheme through which these methods are to be applied, and the actual practice of the methods, must be such as to meet all requirements just as far as is possible without allowing the bookkeeping to become of more importance than the transactions themselves:

1. The record should be completely self-explanatory so that at any time in the future the exact facts in regard to any transaction may be recovered without the assistance of memory or verbal explanation.

2. All the transactions should be so classified that their combined effect over any given period or at any time during that period may be ascertained with ease and accuracy.

Let me acknowledge at once that these two objects are not easily attained; nevertheless, we should never be satisfied with anything less.

In the effort to develop a completely self-explanatory record, unless a controlling common sense is continually exercised, a system of red tape may be developed which will be out of all proportion to the actual requirements of the business. The engineer is constantly required to keep proportions in mind; here is an excellent place to exercise his developed faculty in that direction.

In the effort to develop efficiency in methods, over-development into "red tape" must be guarded against continually. This warning is now particularly timely for the reason that "efficiency" is a fad with many who have no real appreciation of what the term covers and who are an example of the blind attempting to lead the blind. Here is required to the very limit the coördination

to be obtained only by the reaction upon each other of theory and practice. Many of the faddists referred to are weak both in theory and practice.

On the Continent of Europe the bookkeeping systems are often burdened with red tape. The same record is often repeated in various forms. Facts which are fully developed and recorded in books outside of the regular books of account are again recorded *in detail* in these regular books of account.

In Great Britain, and perhaps still more so in this country, such costly repetitions are more often avoided.

There is something to be said in favor of each system. By what we may call the continental method, the more complete record is to be found in the regular books of account and, clerical labor being cheaper, the additional cost is not so serious as it would be with us.

Here we save time, which saves money, and for the ordinary run of business our records are less complicated.

But in connection with our practice it is of still greater importance than with the continental practice that all our letter copy-books, invoice copy-books, contract books and all subsidiary and statistical records should be kept accurately and carefully preserved for reference in case of future question or dispute making it necessary to follow the condensed record as found in the regular books of account back to the primary and subsidiary records.

We are now naturally led to consider the question: What are the books usually employed in double-entry bookkeeping?

Whatever the system of bookkeeping, certain books should be kept for our safety as well as for our convenience, such as letter-press copy-books in which *every* letter and every accompanying exhibit or enclosure should be copied unless the enclosures (invoices), for example, are of such a nature as to suggest that they be copied in a special press copy-book. In one book or another, all of our communications should be copied (preferably press-copied, as then we have a facsimile copy) before they are delivered.

Carbon copies, instead of press copies, can be used to advantage, but then the greatest possible care should be exercised to

prevent the mislaying of these important papers. By the use of such loose copies, a complete file can be kept together of each transaction.

There are other record and statistical books, which will differ in function and form according to the business for which they are designed.

Under this last head might be included the contract record of a contractor in which should appear first a memorandum of the chief features of the contract and a specific reference to the book in which the full text of the contract is recorded. Then should be entered in detail all the items included in the contract, and there should be appropriate columns in which to record against each item the date when ordered, when shipped, when received as shown by the *actual acknowledgment* of receipt, the cost, including freight and cartage, etc., and finally the total cost of each item. In passing, let me point out that such a record is of inestimable value to the contractor provided it is conscientiously kept up and finally made to agree with the record as found in the regular books of account; that is, with the total cost as disclosed by the treasurer's books. Such a contract record affords the opportunity to check up estimates of cost with the itemized records of cost in the case of completed contracts, and it also continually reminds us of the wisdom of tabulating in advance all the items required in a certain contract instead of waiting for a reminder in the form of a notice that the work of construction is stopped or delayed because some little, perhaps inexpensive, part has been forgotten.

There are many other such special records, the need for which is suggested by the varying requirements of different lines of business, such as the meter records of a gas company, the policy record of an insurance company, the car record of a railroad company, the time record of any industrial concern, record of bills payable, record of bills receivable, etc.

All these books so far mentioned we may roughly include in one class as subsidiary, auxiliary, and statistical books.

We now come to a consideration of the books included in the other class—the general or principal books of account.

These include, according to certain authorities, some books which, by other authorities, would be described as subsidiary, auxiliary, or statistical books.

For the sake of simplicity, we can say that these general books of account are the

Cash-Book.
Journal.
Ledger.

Some authorities will claim that the cash-book is a portion of the ledger set apart from the other accounts because this account has to be kept in greater detail and hence can be kept more conveniently in a book of different design from that adapted to the adequate keeping of the other ledger accounts. Others will claim that the cash account is so set apart because cash transactions should be recorded at once, whereas all other entries can be posted from the journal and cash account when most convenient; for having completed the chronological record and having kept up the cash record ready for instant reference, the full ledger record, if *need be,* can be completed later. I can supply another reason; namely, that as it is desirable to have the ledger records in compact form, if the *details* of cash account were included within the compass of the ledger binding, we should have either a very bulky volume or be obliged to transfer frequently all of the accounts to a new ledger because the space taken to record the many cash transactions *item by item* had filled all the spare leaves; whereas by keeping cash account in a book by itself that part of the ledger only has to be renewed often.

Still another reason, and a very practical one, which applies to this case and many others in the management of large undertakings, is that as the work has to be divided up between many clerks and bookkeepers, there must be the necessary multiplication of books that all may work at the same time. As an example, where large amounts of cash are being taken in within a limited time and in small individual payments, requiring the employment of a number of receiving clerks, a corresponding number of cash

receipts books have to be employed to supplement the regular cash-book in which the complete cash record is finally condensed.

But, reason as we may, it is found desirable to have a separate book or books, in which to record fully in chronological order all transactions in which cash has changed hands.

I prefer to treat the cash-book as a separate book and then to summarize in the ledger proper, under the heading "Cash Account," all the transactions which are given in detail in the cash-book.

This is done by "posting" from the credit (or creditor) side of the cash-book the total footings in one amount to the credit side of cash account in the ledger, and the total footings of the debit (or debtor) side of the cash-book to the debit side of cash account in the ledger. This posting of the cash-book footings need only be done once a month.

This makes the ledger complete in itself, and a balance can be struck by taking off the balances of all the accounts in the ledger without having to refer to another book—the cash-book—to obtain the balance of cash account to include with the other ledger accounts.

As this requires only the additional posting from the cash-book to the ledger of two more items per month—namely, the total debit footing and the total credit footing—consuming say one half a minute a month or six minutes a year, I can find no valid argument to oppose to the course I here recommend.

Here you see at once, we are discussing variations in the methods employed to put in practice the same principles. Therefore we are considering a question of convenience and not a vital point, and so authorities can disagree safely.

The journal is a book in which all transactions not involving cash are recorded in chronological order with regard to both sides of the transaction; such explanation is included as will make the entry itself completely self-explanatory or will furnish such definite references to other books of record, *naming the book and page,* as will furnish a completely self-explanatory record of the entries carried ("posted") from the journal into the ledger.

Some authorities would amend this statement by saying: "The

journal is a book in which *all* transactions are recorded," etc. That is, some claim that all transactions should be journalized, including all cash items which are completely explained in the chronological record contained in the cash-book.

I prefer to use the journal for such primary entries only as are not set out in the cash-book.

The ledger is the book in which *all the entries covering all transactions* are stored up finally in condensed form for future reference. It is the book in which all the original entries gathered from the cash-book and the journal, as later to be explained, are entered under their respective account-titles and in the proper columns; viz., debtor or creditor.

The process of carrying into the ledger, under the appropriate headings or accounts, the items as recorded in the books of primary record, is called "posting."

The ledger, therefore, shows the final summing up of all business transactions and to it we refer to learn the debtor or creditor balance of any account, personal or impersonal.

Those of you who have had some experience in bookkeeping may be ready to ask why I have not included in my list of principal books of account, the day-book, sales-book, invoice-book, petty cash-book, etc.

The day-book is intended to receive in chronological order the primary record of all transactions, including purchases and sales. Where the transactions are so numerous as to call for it as a matter of convenience, the sales are recorded in a separate sales-book (or books), and the purchases are recorded in a separate invoice-book (or books).

But as far as the character of the entry is concerned, all of this *can* be done in the journal, and hence these books can be considered as sections of the journal.

The petty cash-book is a book in which, for greater convenience, the small cash payments are recorded in chronological order, and are carried later into the general cash-book in one entry, say at the end of each month. The petty cash-book should be used only for the recording of petty cash expenditures, as its name implies. The items should be classified carefully before

transfer to the cash-book proper and a voucher should be filled out and filed with the other cash vouchers. The practice I recommend is to draw such an amount from cash as we think will be sufficient for the month, allowing a reasonable margin, and charge this amount to petty cash on the regular cash-book. At the end of the month, classify the payments to the accounts responsible and charge in cash-book to those accounts, paying back the amount so charged to petty cash. As at the end of each month petty cash is repaid for the amounts paid out during the month, it remains charged or debited only with the amount originally advanced, while the payments as made now appear in the regular cash-book, though in condensed form.

So the principal books of account reduce to the cash-book, the journal and the ledger; and according to many English authorities the cash-book is merged in the ledger; so then we have only the journal and ledger.

I will now show a journal, a cash-book and a ledger in their simplest forms and include a few simple entries to show how these books work together.

JOURNAL

1

				Dr.			Cr.	
19	04							
Nov.	15	Merchandise, Dr.	6	450	00			
		to John. Smith.	14				450	00
		100 bbls. flour $4.50.						
	17	Henry Herbert, Dr.	25	500	00			
		to Merchandise	6				500	00
		100 bbls. flour $5.						

The Dr. and Cr. items are on the one page and the pages are numbered consecutively.

In a business of any magnitude, such purchase and sales items would probably be recorded in separate appropriate books, and later condensed with many other like items and so carried into the journal for posting into the ledger. There is considerable variation in the practice, but the above entries serve my present purpose, and especially in pointing out the difference between the journal and the cash-book as to posting from them to the ledger.

CASH-BOOK

2
Dr.

19 04						
Dec. 12	To Henry Herbert.	100 bbls. flour.	25		500	00

2
Cr.

19 04						
Dec. 10	By John. Smith.	100 bbls. flour.	14		450	00
16	" Expense acct.	Webster & Co., stationery.	3		16	50

The above represents two pages—the Dr. items are on the left page and the Cr. items on the right page. The pages are numbered 1 and 1, 2 and 2, 3 and 3, etc.

This because it requires two pages to cover the same date and the pages are numbered accordingly.

LEDGER

1

Dr. CASH ACCOUNT Cr.

19 04					19 04					
Dec. 12		2	500	00	Dec. 10		2	450	00
					16		"	16	50

3

Dr. EXPENSE ACCOUNT Cr.

19 04									
Dec. 16	To cash.	2	16	50					

Dr. MERCHANDISE ACCOUNT 6 Cr.

1904							1904						
Nov.	15	To Journal.	1		450	00	Nov.	17	By Journal.	1		500	00

Dr. JOHN SMITH 14 Cr.

1904							1904						
Dec.	10	To cash.	2		450	00	Nov.	15	By Journal.	1		450	00

Dr. HENRY HERBERT 25 Cr.

1904							1904						
Nov.	17	To Journal.	1		500	00	Dec.	12	By cash.	2		500	00

The Dr. and Cr. items of the same account are on the one page. The numbers 1, 3, 6, 14 and 25 are pages in Ledger.

In the journal the entries are made in chronological order. The debit and credit items are shown on the same page. In the form shown, the two columns for debit and credit are side by side at the right of the page, the debit column, however, to the left of the credit column, thus conforming to the arbitrary rule that debit items shall go to the left and credit items to the right. The titles of the accounts and the complete explanation of the entry appear in the main space in the center, the date in the column at the left, the amount in *both* the debit and credit dollars-and-cents columns.

In the cash-book the entries are made in chronological order, the debit items on the left page and the credit items on the

opposite page to the right. Two pages are required for the same date. Items of the same date must be kept on opposite pages, and where the debit and credit items are not equal in number, the lower horizontal lines of one or the other side are left blank, a line being drawn diagonally up and across the blank portion of the page to indicate that it is not to be occupied. At the left of each page are the columns for the date, month, and day. Next are the two broad columns for the descriptive matter, the first for the title of account and the next for explanation. If the account is an impersonal one, such as "Expense," then the first of these two columns is occupied by the title of the account and the next column contains the name of the party paying or receiving the cash. In the column between the descriptive matter and the columns for dollars and cents are placed the numbers of the pages in the ledger containing the accounts to which the cash items have been posted. For instance, Henry Herbert's account is shown as occupying page 25 of the ledger. The dollars and cents are entered in the columns at the right of each page, debit on the left page and credit on the right page.

In the ledger the entries are in chronological order *as far as each account is concerned,* but the several accounts are placed in the book as found to be most convenient. The entries are "posted" from the primary records into the ledger under the title of the account involved. Here the debit and credit items are on a single page, but, unlike the journal, the page is divided vertically through the center, the left half being devoted to the debit items and the right half to the credit items.

These books, particularly the cash-book and the journal, are ruled in different ways to meet the special wants of the business concerned or the individual opinions of the bookkeeper or accountant in charge. For instance, in the journal sometimes the debit dollars-and-cents columns are on the left side of the page, the credit columns on the right side and the space reserved for descriptive matter is in the center.

Again, cash and other books are frequently ruled with extra dollars-and-cents columns to receive the entries for certain accounts only, leaving the one column as before for miscellaneous

items. For instance, there might be on each side of the cash-book an extra dollars-and-cents column for merchandise account, for the reason that a large part of all the entries passing through the cash-book were on account of merchandise. Then these extra columns would be headed "Merchandise Account" and the other columns "General" or "Miscellaneous." Then the total footings of the merchandise columns could be carried into the general ledger in one debit item and one credit item at the end of the month, making a saving in labor, more or less important according to the volume of business involved; and so the cash-book could be ruled for a number of accounts in which the entries were most numerous. No matter how this ruling may be varied, no matter whether one page or two pages are required for the debit and credit items, the arbitrary rule holds good that the credit column is always to the right of the debit column.

Coming back to the examples I have given, let us trace the entries through the several books.

In the journal is recorded first the purchase and receipt from John Smith of 100 barrels of flour. We charge or debit the impersonal or speculative account, merchandise, with $450, because it has received the flour, and we credit John Smith with a like amount because he has given the flour to our merchandise account.

Then we record the sale of 100 barrels of flour to Henry Herbert at $5.00 per barrel. This time "Merchandise" gives up the flour to Herbert, so we debit Herbert's account and credit merchandise account with $500. Through merchandise account we wish to keep track of the losses and gains from the purchase and sale of merchandise; so for all merchandise purchased we debit the account and for all merchandise sold we credit the account. If all the merchandise bought had been sold, then if the total of the credit items in merchandise account in our ledger exceeds the total of the debit items, the difference or "balance" would be our *gross* profit on all the transactions involved. But if there were merchandise still unsold, the merchandise in stock must be added at cost prices to the total of the credit items, and the balance is gross profit, subject however,

to any loss that may occur in selling the remaining merchandise at prices lower than the purchase prices. Such possible depreciation in all merchandise and all assets must be taken into account in calculating profit and loss. Following the same process, if the debit total exceeds the credit total, it is shown that the trading has resulted in a loss.

Coming now to the cash-book, on December 10 we pay Smith for the flour received from him, so we credit cash with having paid out this money, and this entry also indicates a debit to Smith.

On December 12 Herbert pays us for the 100 barrels of flour sold to him. This $500 is debited to cash because cash receives the money, and by implication this debit entry to cash makes a credit entry to Herbert.

On December 16 we pay out $16.50 for stationery and we debit this to expense account, to which account we expect to charge miscellaneous items of expense during the year; so we have at the end of the year a summary of the cost of all the expense items included in this account according to our predetermined classification.

Now coming to the ledger:

We "post" the entries from the journal and the cash-book into the proper accounts in the ledger.

As I have explained already, the entries in the journal are complete. That is, the debit and the credit side of each transaction is shown; each amount is shown twice, once in the debit column and once in the credit column. So in posting into the ledger we post from the debit column of the journal into the debit column of the proper account in the ledger, and from the credit column of the journal into the credit column of the proper account in the ledger.

But when we post from the cash-book into the ledger we have to remember that what is to the debit of cash is to the credit of Herbert; and that the first item to credit of cash is to the debit of Smith and the second item is to the debit of expense account.

So in posting these items from cash-book into ledger we post from the left or debit side of cash to the right or credit side of the ledger; and from the right or credit side of cash to the left or debit side of the ledger.

Then, if we summarize in the ledger the cash account as shown in detail in the cash-book, as I have recommended, at the end of the month we post the total debit footings of cash-book into cash account in the ledger on the debit side, and the total credit footings of cash-book into the cash account in ledger on the credit side. There is no reversal in the posting in this case, because cash account in the ledger is simply a condensed form of cash account as shown in the cash-book.

If, according to the older practice, a practice still maintained by some, we journalize all cash items, the entries I have shown in the cash-book would be as follows:

JOURNAL

1904.			Dr.		Cr.	
Dec.	10	Jno. Smith, Dr. to Cash. Payment in full for 100 bbls. flour.	450	00	450	00
	12	Cash, Dr. to Henry Herbert. Received in full for 100 bbls. flour.	500	00	500	00
	16	Expense acct., Dr. to Cash. P'd to Webster & Co. for bill of stationery	16	50	16	50

In this case both sides of each transaction are shown. In the case of the first entry, we not only show the debit of $450 to Smith, but we show just as explicitly the credit of $450 to cash. As the entry is made as a basis for recording two sides of the transaction under the proper headings in the ledger, it is apparent that we must post these entries, debit and credit, into the ledger as they are shown in the journal.

But now if we omit the journalizing of cash, and enter each transaction at once in cash account in the cash-book, we must remember that that entry only records one side of the transaction and we must post the entry into the ledger in the account involved on the other side of this cash transaction.

So in the case of the John Smith entry as first shown in the cash-book, we must post that cash credit entry as a debit entry in the John Smith account, just as much as if both sides of the

transaction had been shown as in the corresponding journal entry.

If these entries as made in the cash-book and the journal are compared, and it is borne in mind that these entries record exactly the same transactions, there should be no longer any trouble in understanding why we reverse in posting from the cash-book to the ledger and do not reverse in posting from the journal. *Remember I have introduced this example of journalizing cash only to illustrate this difference in posting and not to indicate that cash items should be journalized.*

In the journal I have written the entries thus:

John Smith, Dr.,	$450.00	
To Cash,		$450.00

This would be just as correct and self-explanatory to a book-keeper if written:

John Smith,	$450.00	
Cash,		$450.00

"Dr." and "to" can be omitted safely because the debit and credit columns fully indicate that Smith's account is debited and cash account is credited.

Also in the cash-book and ledger on the debit side I have made the entries:

To Henry Herbert, *To* Cash, and *To* Journal:

and on the credit side:

By John Smith, *By* Expense Account, *By* Journal, and *By* Cash.

In the John Smith account "to cash" signifies that *so far as that one transaction is concerned,* John Smith is debtor to cash account or the cashier for money paid by cash to John Smith.

In the cash account this same transaction is recorded "By John Smith"—which signifies that cash account or the cashier is entitled to take credit "by" (or for) the amount paid to Smith.

But this is all clearly shown without the use of the words "to"

and "by" if the double-entry system of bookkeeping is understood.

Therefore, while this use of the words "to" and "by" is in conformity with bookkeeping traditions, it is not obligatory.

The older practice in writing the headings for ledger accounts, still followed generally in Europe and less frequently here, is as follows:

signifying that entries on the left are to the debit of John Smith while those to the right are opposed or against these debits and therefore to his credit.

The practice in the United States is becoming more and more general, to simply write over the center of the account, "John Smith," omitting as surplusage not only the word "contra," but also "Dr." and "Cr."

It must now be fully apparent that for every debit item carried into the ledger there must be a like credit item; and for every credit item a like debit item. *In this connection we must recollect that if we do not have a cash account in the ledger we must consider the cash-book as part of the ledger.*

Considering the ledger accounts which I have shown, we find the following debit and credit balances:

	DR.	CR.
Expense Account,	$16.50	
Merchandise Account,		$50.00
Cash Account,	33.50	
Showing the debits and credits in balance,	$50.00	$50.00

What is true in the case of these few simple entries would be true no matter how many and how complicated the entries were, provided the work was correctly performed.

It will be noticed that in this ledger balance I have taken no notice of Smith's account and Herbert's account because in each case the debit and credit items balance or cancel each other.

Analysing the figures taken from the ledger, we find that by trading in merchandise we have made a gross profit of $50, from which we must deduct $16.50 for expenses, leaving $33.50 net profit, and this net profit we find as cash in hand as shown by cash account.

I have been asked by members of my classes what I meant by a debit balance or a credit balance.

The fact that such a question was asked emphasizes the necessity for some instruction in accountancy, if only to enable the engineer to understand the language of business. It is not only necessary that the engineer should understand this language as correctly used, but certainly he should know that there are many variations in the language of accountancy. Unfortunately there is not a little confusion caused by non-uniformity in accountancy terminology and especially so in the United States. This is most unfortunate at this particular time when the writers for our papers and magazines frequently attempt to instruct the public without a sufficient knowledge of the exact meaning of the terms employed. The fault sometimes rests with the accountants and bookkeepers who are careless with regard to the meanings of such terms as earnings, net earnings, profits, net profits, surplus, etc. The public has of late frequently been misled and deliberately deceived by the incorrect use of such terms. Our legislatures and our courts have added to the confusion by failing, as an example, to make the proper distinction between such terms as income, receipts, earnings, profits—gross and net. When in doubt yourself, or when you think there may be any question on the part of those you are addressing, you should explain the meaning of the terms used. As to the meaning of the terms now to be explained there can be no question.

A debtor, or debit, balance is the amount by which the debit side of an account exceeds the credit side.

A creditor, or credit, balance is the amount by which the credit side of an account exceeds the debit side.

A question recently asked and many similar experiences indicate that the relation of cash to the business in which cash is concerned is at times puzzling.

Let us consider for the moment that the owner does nothing for himself and consequently assume that when a person pays in a sum of money to the owner's business it is not he (the owner) who receives it, but his cashier or his cash account that receives it for him and is accordingly his debtor for the amount received. The cashier has received the money on behalf of his employer and therefore is liable for it and must subsequently account for it. Until he so accounts he is a debtor for the amount so received.

If, then, the cashier is made debtor for each amount which he receives on behalf of his employer, we must make him *as far as any one transaction is concerned* the employer's creditor when he pays out money on behalf of the employer.

If we balance up between the debit items and the credit items we may find that the cashier is still debtor for a balance of cash on hand; but, nevertheless, he has been made creditor for each item of cash paid out; and it is by balancing up, or placing against each other, the debit and credit items that we learn the final result as to whether there is a debit or a credit balance. If there is a debit balance of cash it indicates that the cashier being debtor, there is a balance of cash in his hands for account of the owner. If there is a credit balance to cash account, it indicates that there is a deficit—there is no cash on hand, but there *is money* owing to the cashier.

Again, suppose you are your own cashier, and suppose you pay cash to a person from whom you have purchased merchandise. You became his debtor when you received his merchandise, and he became your creditor. When you paid him in cash for the merchandise, by that transaction, considered by itself, you became his creditor and he became your debtor. The one who receives is always the debtor and the one who gives is always the creditor, and this whether the thing given and received is merchandise, services, real estate, cash, or any other kind of property. Only in case of cash transfer does the entry appear in the cash-book,

and then the entry is made with respect to the owner of the cash-book.

This relationship of cash to the business should be turned over in the mind and viewed from different standpoints, and especially you should get into the habit of looking at the transactions as shown on the books of account from the standpoint of the outsider; that is, you should develop the capacity of correctly interpreting a statement of account whether you look at it from the standpoint of the proprietor or the standpoint of some one doing business with the proprietor; you should cultivate the capacity for seeing both sides of every transaction.

While speaking of cash, let me give another hint which frequently appears to be needed. Do not assume that because a profit has been secured by a certain transaction or a number of transactions, that this profit can be found in the form of cash; it may be in some other form of asset.

ACCOUNTANCY

Classification of Transactions and Grouping of Accounts

I have shown already in an elementary way the classifying of certain transactions by the assigning of each transaction to some predetermined account. These accounts are permanently established in the ledger. The title of each account is written at the head of the page or pages assigned to it, and is entered also in an alphabetical index.

A simple rule, neglected too often, is to assign to each account, as far as possible, a title which shall be self-explanatory.

In a business of any magnitude, the scheme of classification is of prime importance; it should be planned broadly and in detail to meet all the legal and commercial requirements of the business. This means that the classification should give full opportunities for the analysis of all branches of the business, and therefore, the planning should be the work of a thoroughly competent accountant assisted by the specialists in charge of the several branches of the business.

The schemes of classification, as employed by our large public utility and industrial corporations, are generally the result of experience. As the business has developed and new needs have become apparent, the system of accounting, including the classification, has been developed more or less completely to meet the enlarged requirements. In this country, great progress has been made in this direction in late years.

The present more usual practice is to establish certain general accounts which serve to classify the transactions broadly, and then to subdivide these general accounts under such subordinate headings as may be required for the purposes of more complete analysis. It must not be forgotten that efficient and economical management in great measure depends upon the means provided by the accountant for the complete and accurate analysis of operating results. Here the danger of system degenerating into red tape must be guarded against constantly.

In the endeavor to provide the means for closely detailed analysis of the affairs of a large concern, and more especially where the business is divided up into many subordinate companies, the system of classification becomes so extended that every possible provision must be made for ready reference and *for uniform practice in the application of the system.*

Frequently, besides the title, the account is identified by a numeral, or letter, or both. A practice which is now quite usual is to indicate for reference the general accounts by the letters of the alphabet and the subdivision of these accounts by numerals. For instance, if we have a general account called manufacturing, and to that we assign the letter A, we might have many sub-accounts to cover the subdivisions of the cost of manufacturing. Suppose manufacturing labor was the seventh subaccount, then it would be indicated by A-7.

Such an elaborate system of classification should be fully set forth and explained in a book especially designed for the purpose. A page should be devoted to the description of each account. On this page should appear, first, the title of the account with its letter and number; then a general statement of the scope and purpose of the account; then a schedule of all the items to be carried into the account; then, if need be, the special journal entries involved, and accompanying explanations; and finally general explanatory notes. Thus the best has been done to enable a competent bookkeeper to put the scheme into effect. There should also be an index of all items of expenditure, referring by page to the accounts under which they are scheduled.

Some accountants do not favor so much detail in connection with the classification book. My experience goes to show, even with the fullest explanation that we can give, that it is at times difficult for a competent bookkeeper to decide questions of classification; if, then, we are looking for uniform results, we must afford every possible assistance to the bookkeeper and to those upon whom he depends for primary data. To ensure uniformity in the application of an extended scheme of classification, the memory alone should not be relied upon for any essential feature of the scheme.

I am also strongly in favor of including in the classification book the forms for the regular monthly journal entries, and also a full statement of the rules for closing the books at the end of the fiscal period, accompanied by the forms to be used in making the adjusting and closing journal entries.

A method which I followed in developing a uniform system of accounts used in the management of a large number of subordinate companies operated by a controlling company—the first system of that kind developed for the particular business involved, and one of the first uniform systems established in this country—was always to have before me, when approving vouchers, the classification record. Whenever a decision had to be made, as to how a certain item should be classified, whether it was an original decision or correcting some rule already made, the entry was made at once upon my own copy of the classification record, and, at short intervals, these corrections were manifolded and sent out to all the subordinate offices, and at longer intervals complete copies of the revised classification record were so distributed.

Any of you who may become responsible for the planning of a scheme of classification for some new line of business may find it advisable to follow this course rather than to attempt to devise a completely comprehensive scheme in advance of actual experience.

There is the utmost necessity for utilizing all available knowledge and experience in the planning of an adequate scheme of classification. But we must not fall into the error which so often operates to disqualify comparative data furnished by governmental bodies and others; namely, in assuming that because certain rules are laid down to cover the making of records, that necessarily those rules have been followed. In the operation of a single company it is difficult to follow the scheme of classification with such uniformity as to give figures absolutely reliable for purposes of comparison. If we are comparing the operating data from a number of corporations employing the same scheme of classification, the difficulties of securing accurate comparisons are correspondingly multiplied. So, then, to secure from a

uniform system of accounting as applied to the operation of a number of corporations the data for reliable comparisons, two difficult propositions must be solved:

First, the planning of a scheme of classification which shall furnish the means for analysing the results obtained by all branches of the business.

Second, the strict compliance with the rules of classification on the part of all who in any way contribute to the classifying of transactions in all the companies involved in the comparison.

This means that it is practically impossible to secure such comparative data of absolute reliability, though they can be secured of sufficient reliability for the comparisons to be of great practical value.

Many bookkeepers and some accountants will not agree with me in the opinions thus expressed as to the difficulty of securing accounting data that can be accepted blindly for comparisons. I can say that my opinion is based upon a wide experience in the management of many companies operating under a uniform system of classification and accounting, the operations of the component companies being checked constantly by expert auditors and engineer inspectors, and all striving to secure the result aimed for; namely, completely reliable comparisons. One difficulty which many fail to provide for adequately, is having to rely in many cases upon indifferent and ignorant minor employees for the primary information upon which certain expenditures are classified. A mistake here means a mistake at the very foundation of the scheme.

Let the warning here sounded also serve as a caution against a blind acceptance of tables of data published by branches of the government, official bodies, and especially reform associations. Frequently these data which are offered for comparison are the tabulation of figures furnished by many people competent and incompetent, all presumed to have made an intelligent effort to interpret directions furnished to secure uniform returns, these directions, however, being probably incomplete and ambiguous, and so subject to many variations in the interpretation. Many

have been misled and many have succeeded in misleading by this kind of "comparative data."

Undoubtedly some of the schemes of classification which have been developed of late for the control of public utility corporations, especially by certain of the State Public Service Commissions, are unnecessarily intricate and subdivided in some parts and not sufficiently subdivided in other parts. I think we may safely assume that in some cases the members of the commissions and some of their employees could not pass an examination on the scheme of accounting which the corporations under their control are required to accept and employ. Where there is an honest desire on the part of the commission to assist rather than hamper and obstruct the companies under their control, the co-operation thus developed will bring about systems which will serve at once the needs of the corporations and the interests of the public.

I by no means contend, however, that the simplest system is the one containing the least number of accounts. While a condensation of accounts may lessen the actual labor in the bookkeeping department, it may likewise add to the labors of the conscientious manager, as such a scheme of classification affords him insufficient opportunity to analyze effectively his operating costs and to make the required comparisons of his own results between periods and with the results of other companies in the same line of business. The manager so handicapped can make the complete analyses and comparisons only by laboriously subdividing these condensed book accounts, as occasion demands, at the expense of his valuable time and energy which could be spent better in some other way.

It sometimes happens that, under the same general management, provision may well be made for two schemes of classification, one less subdivided than the other. The senior or more complete scheme, for the larger companies, and the junior, or more condensed scheme, for the smaller companies.

In the general scheme of classification developed by a committee of the American Gas Light Association, the intention was to provide for any and all of the gas companies of the United States,

large and small. The plan provided a senior and a junior classification. In both schemes the same general accounts were adopted to cover broadly the same classes of items, but in the junior scheme these general accounts did not include so many subaccounts as in the senior scheme. By this plan comparisons could be made between the operating results of the larger and smaller companies as to the larger divisions of cost items, but when it came to the more complete subdivision of the items of cost the junior system failed to afford means for ready comparison.

Among accountants there is much difference of opinion as to the grouping of accounts. To my mind, much of what has been written on this subject is more academic than practical.

One of the divisions that can be found in some of the English text-books is as follows:

Real Accounts. Dealing with actual property.

Personal Accounts. Showing the record of transactions between the owner and the various persons with whom he has business transactions.

Nominal Accounts. Dealing with various forms of income and expenditures.

Another division recommended is Personal, Real and Imaginary Accounts. The first two cover the same ground as shown above, and the last takes account of stock and expense accounts.

Another division is as follows:

Speculative Accounts. Having to do with merchandise, real estate, interest, expense, etc.

Non-Speculative Accounts Having to do with items from which neither loss nor gain is to be directly expected, such as cash, bills payable, bills receivable, personal accounts, etc. As an example of the modifications that may be introduced here a loss may be developed by bills receivable not being received at their full face value.

Another division is Personal and Impersonal Accounts:

Personal Accounts. As above explained, the accounts with individuals, firms, and companies with which we do business.

In connection with these accounts, we must in making our entries always consider the other party to the account.

Impersonal Accounts. As merchandise, expenses, repairs, wages, salaries, etc., varying with the scheme of classification. Here we have to consider only the several relationships between the different features of our own business. In the case of personal accounts, the journal cross entries, in which one account is debited and another account is credited, cannot be made without taking into account the rights of both parties to the transaction. In the case of impersonal accounts, such cross entries can be made without doing injustice to anyone except the proprietor of the business, though of course the result might be to falsify the accounts.

As I have said, the differences of opinion as to these groupings of accounts is more academic than practical.

There is one practical advantage, however, in considering these different groupings or divisions of accounts—it brings one to consider the principles of accountancy from several points of view. The main thing is to bear in mind continually that, no matter what the name of the account, we must discriminate most carefully in the treatment of our accounts with respect to assets and liabilities, and with respect to items of income and expense. This point I shall emphasize in connection with our study of depreciation. If depreciation is not provided for from earnings,—and I am referring to depreciation of plant, depreciation of manufactured stock, depreciation of stock in course of manufacture or raw material to be manufactured into stock—we are depleting our assets and so drawing upon our capital.

In this connection I shall state a rule which is the only rule I shall require you to memorize. As we proceed in our work I shall expect you to test this rule by the application of principles, and especially when we come to the analysis of the ledger trial balance and the ledger balance sheet.

1. An item on the *left* or *debit* side of the ledger (a) is an asset if the amount eventually will be received; (b) is a loss if the amount eventually will not be received.

2. An item on the *right* or *credit* side of the ledger (a) is a liability if the amount will eventually have to be paid; (b) is a gain if the amount will eventually not have to be paid.

I am not an advocate of placing dependence upon memorized rules, but I make an exception here because the rule is far more suggestive of the principles involved than is ordinarily the case.

Let me amplify somewhat. If we have paid out money and it is to be returned to us, say, by the sale of the thing in which the money has been invested, then the balance to the debit of the account involved represents an asset.

If, on the other hand, we have paid out money which is not to be returned to us, then the balance to the debit of the account involved must be considered as a loss.

If money has been paid to us, and we have to pay it back, then the balance to the credit of the account involved represents a liability.

If, on the other hand, we have received money which we do not have to pay back, then the balance to the credit of the account involved represents a gain. As will be seen later, our expectations may not be realized and so an asset may be transformed into a loss.

To the student of accountancy it is at first a stumbling-block to find that losses and assets are grouped together as debit balances, and that gains and liabilities are grouped together as credit balances. The accounts thus grouped together appear to be in direct opposition to each other and therefore a contradiction seems to be involved. A study of this rule shows at once that this is not an arbitrary arrangement, but that it is in accordance with principle. All money paid out goes to the debit of some account necessarily. Whether it is to be an asset or a loss depends upon whether the money so paid out is represented by property acquired or not. In the same way on the other side, if we receive money we must give credit to some account, and whether this is to be considered as a gain or a liability depends upon whether we have to pay back that money or not.

This goes to emphasize what I have already said as to the

necessity of discriminating most carefully in classifying transactions between asset and liability accounts, on one hand, and income and expense accounts, on the other hand. In the first group we have represented in the liabilities the capital permanently or temporarily invested in the business; and in the assets we have represented the way in which that capital has been invested. In the loss and gain accounts, during each fiscal period, we follow all the items of income and expense through the various channels in which the capital is employed in the effort to make a profit and increase our assets.

Although I shall refer to the subject more fully later on, it is convenient here to refer briefly to the trial balance and balance sheet, and the difference between the two.

At any time and especially at the end of any fiscal period we must go to our ledger to determine what has been the financial gain or loss as the result of our operations to date. Supposing that all entries from the cash-book and the journal have been posted in the ledger, we shall find in that book all the asset and liability accounts and all the loss and gain accounts which are still open. The balances of the asset and liability accounts will be found as they were at the beginning of the fiscal period, increased or decreased by the transactions of the period. The balances of loss and gain accounts will represent all and only the income and expense items involved in the transactions of the period.

The first thing required is to see if the ledger is in balance; that is, if the sum of all the debit balances equals the sum of all the credit balances. To this end each open account is footed up in pencil on the debit and the credit sides. If the footings are the same, or balance, the account is closed for the time being. If the footing on one side is greater than on the other side, the "balance" is found by deducting the lesser amount from the greater. The balance so found is written in pencil on the side on which the balance is found and also written on a sheet of paper ruled for debit and credit items. Having thus footed up all the open accounts and entered the balances as found upon the trial balance sheet, all the debit and all the credit balances are footed. If the column containing the debit balances totals the same as

the column containing the credit balances, we assume that the ledger is correct. If these totals are not the same, the next thing to be done is to find the error or errors and make the necessary corrections. No matter how small the difference, a balance should not be "forced." Some accountants and bookkeepers favor the practice of placing on the trial balance and ledger balance sheets the debit and credit footings of each open account in addition to the balance.

With the trial balance before us, we study all the balances to see if any adjustments need to be made between the several accounts. For instance, if we have an account to show what has been invested in office furniture and fixtures, we may feel sure that this asset has lost part of its value during the year by reason of depreciation. We must then estimate the amount of this depreciation and treat that amount as one of the losses of the year. But as this loss is not represented by the payment of cash, we must make an appropriate entry in the journal, charging or debiting this loss to some expense account, or direct to Loss and Gain account, as later to be described. But this entry must show a credit as well as a debit if our ledger is to be kept in balance, and also we must reduce the "book value" of office furniture and fixtures because its value as an asset has been decreased. So the amount of depreciation is also *credited* to Office Furniture and Fixtures Account. The journal entry then appears something like this:

Loss and Gain Account, Dr.,	$500.00	
To Office Furniture and Fixtures Account,		$500.00

Depreciation on office furniture and fixtures for the year, estimated at 10 per cent on $5,000.

This entry being posted in the ledger to the debit of Loss and Gain Account and the credit of Office Furniture and Fixtures Account, the proper adjustment has been effected as to this item of loss as estimated.

There may be many other adjusting entries to be made in the journal before the Loss and Gain Account can be made up; for instance, certain accounts receivable may be found to be worth less than their face value; other items of depreciation may have

to be accounted for; the inventories of merchandise and material may fail to correspond with the balances of the involved accounts —then adjusting entries, fully self-explanatory in each case, must be made in the journal and posted into the ledger.

When all adjusting entries have been made then all the loss accounts should be *debited* to Loss and Gain Account, and all the gain accounts should be *credited* to Loss and Gain Account, which condenses all the losses and all the gains in the one account and so enables us to strike a balance between the losses and gains and to determine whether the result of the year's operations has been to produce a profit or a loss, and the amount in either case.

Again, these entries must in each case show a debit and a credit to keep the ledger in balance, by cancelling the individual balances when they are grouped in the Loss and Gain Account.

The journal entry to close the losses into Loss and Gain Account might be as follows:

Loss and Gain Account, Dr.,	$125,000.00	
To Sundry Accounts as below:		
Expense Account,		$ 3,000.00
Rent Account,		2,000.00
Manufacturing Labor Account,		25,000.00
Manufacturing Material Account,		50,000.00
Taxes Account,		10,000.00
Salaries,		15,000.00
Selling Expense,		20,000.00

Then follows the explanation to show that this entry is made to close the books for the year (or fiscal period) ending, say, December 31, 1910.

Next comes the journal entry required to carry the gain items into the Loss and Gain Account, as follows:

Sundry Accounts as below, Dr.		
To Loss and Gain Account,		$155,000.00
Merchandise Sales Account,	$150,000.00	
Interest Account,	5,000.00	

Then follows the explanation, which in every case must be complete.

Interest Account does not indicate by its title whether it is a loss or gain item. This depends upon whether we pay out more as interest on money borrowed or collect more as interest on money loaned.

In both of these entries I fill in the amounts simply to illustrate that the total amount debited or credited to Loss and Gain Account must be the sum of the separate items in each case.

Having posted these entries into the ledger, the Balance Sheet is made by taking off the balances of all accounts yet open on the ledger after completing this process of adjusting and closing all losses and gains into Loss and Gain account.

If the posting of all adjusting and closing entries has been correctly performed, the debit and credit columns on the Balance Sheet will be found to foot up the same—that is, to balance.

Thus we see that the Ledger Trial Balance gives the balances of all open accounts on the ledger before closing the books for any fiscal period, and the Ledger Balance Sheet gives the balances of all open accounts after all asset and liability accounts have been adjusted as may be necessary, and all losses and gains as shown by the several income and expense accounts have been concentrated in the one Loss and Gain Account.

Speaking generally, on a Balance Sheet there are only asset and liability items and the one balance to Loss and Gain Account, either debit, showing a loss, or credit, showing a profit.

Now this balance, either to the debit or credit of Loss and Gain Account, can be considered—and by many accountants is always so considered—as either an asset or a liability. When so treated it is said that a Balance Sheet contains only assets and liabilities; assets on the left, and liabilities on the right.

The reasoning is as follows:

If the Loss and Gain balance is on the debit side of the ledger, then it is considered as an asset; for as it represents a loss or deficit made during the year, and the proprietors of the business, as individuals, owe it to the business as a whole, in that sense it is an asset to be made good out of future profits or by assessment on the proprietors. It represents an asset of the business as a whole, but a liability of the proprietors as individuals. But if, as

is more generally the case, the balance is found to be on the credit side of the ledger, then it indicates that a profit was made during the fiscal period, and the amount of this profit is owing by the business as a whole to the proprietors as individuals, and hence is a liability of the business.

This is the way in which the subject is considered by most of the English accountants and by many of our accountants, and there should be no trouble in understanding it from this explanation. Of course, in this case, we must be careful to bear in mind always that the business must be considered as something quite apart from the person or persons to whom the business belongs.

Suppose the business in addition to capital has a surplus of $1,000. Then the proprietor is a creditor of the business for $1,000. In other words, the business makes no distinction between its proprietor and any other creditor.

Some high authorities prefer to consider the Balance Sheet more from the point of view of proprietorship, and this appeals to many as being more in accord with the facts, as follows:

The Ledger Balance, as developed from the Ledger Trial Balance, as already explained, shows assets on the left or debit side, and liabilities and *proprietorship* on the right or credit side; and, as in the balance sheet the sum of the items on the debit side must be exactly the sum of the items on the credit side, we have the equation:

$$\text{Assets} = \text{Liabilities} + \text{Proprietorship}$$

or

$$\text{Assets} - \text{Liabilities} = \text{Proprietorship}.$$

Here the assets will probably be in part made up of property held by the proprietor and in part of debts due to the proprietor. The liabilities will be entirely indebtedness due by the proprietor.

Probably this presentation of the matter appeals more directly to the layman, for it is easily understood without instruction in accountancy that the value of our proprietorship in a business is the balance left after deducting our liabilities from our assets. A

balance sheet to illustrate this point of view, might be in form as follows:

Assets:		Liabilities:	
.....	$.....	.....	$.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	Total Liabilities:	
.....	.....	Proprietorship:	
.....	.....	.....	$.....
.....	.....	.....	.....
		.....	.....
		.....	.....
Equal Total:	$.....	Equal Total:	$.....

I have already shown that the *general* books of account are, according to some authorities, the journal and ledger, and according to other authorities, the journal, the cash-book, and the ledger. The difference is more apparent than real, for in either case the cash-book is used. The difference is that where the cash-book is considered as one of the general books, the cash totals, debit and credit, are posted into the cash account in the ledger; whereas, in the other case, the cash-book is considered as the cash account of the ledger separately bound.

I have also shown that there may be many subdivisions of these general books of account, in addition to the auxiliary and

statistical books. In carrying out such a scheme of subdivided classification as I have just described, there would be required, in addition to the general ledger, a number of subordinate or class ledgers. A good example of this is the many personal ledgers required in the keeping of the accounts with its depositors by a large bank, the consumers' ledgers of a gas company, etc.

As a general proposition, each account in the general ledger, if subdivided, should comprise or summarize the entire contents of one subordinate ledger or a group of the subordinate ledgers.

The general ledger accounts deal more with whole classes of like nature; whereas, the subordinate ledger deals with each individual asset or liability, or with groups which may be treated as individual. It is the province of the general ledger to give information in grand totals, and it is the function of the subordinate ledger to give information in detail, especially required for the analysis of working results and the comparison between the results obtained during different fiscal periods and between different enterprises involved in the same character of business. Subordinate ledgers and cash receipts books are multiplied in some cases to enable many clerks to work at the same time. This is especially true in the case of books employed in connection with a great number of personal accounts, the names of the customers being arranged alphabetically and each ledger or cash receipts book being devoted to a certain section of the alphabet.

The practice with some is to give only the general accounts a place in the general ledger, and to carry all the subdivisions of these few general accounts in a series of subordinate ledgers. In this case the general ledger and the general accounts therein contained only give a bird's-eye view of the transactions. For some purposes this broad view is sufficient. For the detailed analyses and reports based thereon, the subordinate ledgers and records have to be consulted.

In any and every case a Balance Sheet taken from the general ledger should be a true and complete exhibit of the condition of the business. Among the assets should be included all amounts owing for merchandise delivered or service rendered,

and among the liabilities should be included all debts incurred but not paid. In view of the fact that there are still to be found concerns of considerable magnitude which keep their books on a cash basis only—a most reprehensible practice—I again wish to impress upon you that the fundamental principles of sound accountancy demand that all transactions as they occur shall be recorded completely, and from the first entry, perhaps in some subsidiary book, to the last entry, which will be in the general ledger in condensed form, there shall be found a complete and truthful record of each and every transaction.

There need not be, and there must not be, any violation of this fundamental rule by reason of the compressing of many transactions within small compass in the general ledger.

ACCOUNTANCY

Advance Payments and Accrued Expenses

So important is it that you should understand that books of account should not be so kept as to show only transactions which have resulted in the passing of cash, but must show all transactions which involve liability to or from the other parties to the transactions, that I shall here further develop the point which I have covered briefly in my reference to adjusting entries. Without a clear understanding of the importance of this feature of accountancy, your study of the subject would be nearly valueless. It is because this feature is lost sight of that many statements of account are grossly misleading.

Let us suppose that a manufacturing concern has to pay a large royalty on some patented invention and that by agreement the payments on this royalty are to be made semi-annually. Suppose it is intended that there shall be prepared a complete statement of the results of each month's operations—that is, a monthly statement of loss and gain. If in the statements for the ten months in which no royalty settlements are made, there is no mention made of these royalties, it is apparent that the income for two months of each year will be called upon to meet a large item of cost which should be spread pro rata over all of the twelve months of the year. Thus it will be made to appear that during the other ten months of the year the operating cost has been lower than the facts called for and so the profits are made to appear too large. It is quite possible that a most superficial examination of these monthly statements would show the reason for this wide variation in the rate of profit, but some calculation on the side would still be required to show the facts in connection with an exact and fair comparison. The obvious comment on such incomplete and imperfect monthly statements is, "Why not make them complete and self-explanatory?" This means, then, that every statement of loss and gain should include not only the actual payments made during the period

covered by the report but also every item of accrued loss. It makes no difference whether the actual payment has been made or not, if the fiscal period covered by the report is, under the conditions of the business, required to meet a certain item of loss, the liability therefor must be included as one of the loss items of the period.

And the same is true with regard to the income items. In the royalty case cited, considering the other party to the transaction, the receipts are not applicable to the month alone in which they are received, but they are applicable pro rata to each month covered by each payment.

What is important with regard to the monthly statements of loss and gain is much more important with regard to half-yearly and yearly statements, because on these latter are based the calculations as to the division of profits or the paying of dividends. If a considerable item of accrued loss is omitted from a statement of loss and gain, to that extent the profits are shown greater than they are in fact; and if the total profit for the period is paid out in dividends, to that extent the dividend is paid from capital or surplus, and not from the earnings of that period.

From this it is to be seen that in all statements of loss and gain, and especially those upon which dividends are declared, all accrued losses and gains should be included.

Following this point a little farther, if these accrued losses and gains are to appear in a statement of loss and gain, they should first appear in the regular books of account. I specifically make this point, unnecessary as it may appear to some of you, because too frequently I have found that a statement of loss and gain was first made from the regular books of account and then by notes or comments, written or verbal or both, the actual facts were developed. Let me cite one instance: In the case of a manufacturing concern in which I was pecuniarily interested, I discovered that the statements of loss and gain prepared from the books of account were completely misleading and that it was necessary to supplement these statements of account by information on the side, part of it recorded in letter-books, part of it in pocket memoranda, and part not recorded at all. Special dis-

counts had been allowed but not regularly recorded; special settlements of disputed accounts had been agreed upon, but pending the actual settlement, no record of the agreements had been made on the books of account; certain depreciation in manufactured goods had been recognized, but these goods were still carried on the books of account at their full original cost; and so on. This is not an extraordinary case. The man responsible as general manager was not an inexperienced man; on the contrary, he was a man of wide experience, well versed in the principles of accountancy as applied to industrial and commercial affairs, and a man who had before always managed successfully the concerns intrusted to his care.

His fault originated in three causes:

1. The commercial and shop details of this business were different from those of the business in which he had been trained.

2. He did not surround himself with efficient assistants, and as a result he was overworked to the point of being threatened with complete nervous collapse. He was obliged to devote so much of his time to certain details in the shop and the counting-room, that certain other details were completely neglected and there was no time left to maintain a general and comprehensive view of the field.

3. As the results from the business failed to verify his somewhat rosy predictions, he made no great effort to keep in view and on record his accrued and accruing liabilities. And this without any deliberate intention to deceive. It would have been difficult for him in any case to have maintained at all times a completely accurate record of the modifications of his transactions. Pressed upon as he was by the conditions I have named, hoping for improvement in conditions, and being anxious not to alarm unnecessarily those who had invested in the undertaking, naturally his reports failed to show the facts.

And let me warn you that this case I have cited is only one of many which have come under my personal observation and that you must be prepared to meet such conditions in the ordinary run of business. Especially those of you who may be called upon to report upon the value of industrial properties must

appreciate that no final estimate can be made until there is complete accord between the engineering or technical side of the report and the accounting or commercial side of the report; and, in order to be sure that there is this accord, the engineer or technical expert must at least be able to understand, without the assistance of an interpreter, the accounting portion of the report. I have been called upon to investigate many cases worse than the one cited, and I am sorry to say that in some few cases it was quite apparent that the faulty statements of loss and gain were the result of deliberate and studied effort to deceive.

Where there is deliberate intention to cheat, it may require an intimate knowledge of the business to discover the methods employed to deceive.

I cannot attempt to name here the several lines to be watched, but to men who are to be engaged probably in the construction and operation of industrial plants, I may say that a fruitful source of error or opportunity for deception is where the operation of plant and the construction of extensions of plant are proceeding together under the same direction and supervision. If through carelessness, ignorance or intention, items chargeable properly against operating cost are charged against construction, the result is to impair capital and to show profits higher than they are in fact. This mistake is easily made and is hard to discover where the same men are employed on both classes of work. I could give you many instances of this kind.

Referring to the classification book of the American Gas Light Association, I will now consider in some detail three of the accounts therein named and described.

My object is twofold:

First, to illustrate the make-up of a classification book;

Second, to explain in detail the questions involved in advance payment accounts and accrued loss accounts.

It is to be noted with the accounts to be considered there appears no schedule of items chargeable to the accounts, because they have to do only with one item—taxes.

This feature will be brought out later in our study of "Accountancy as Applied to Depreciation."

First, recall the fundamental rule already explained, that in making up a statement of income and expense for any period there must be included all items of expense or loss, whether they have been so far actually paid or not; and that credit must be taken for such amounts as have been paid in advance as applicable to a subsequent period only as items of expense or loss.

These loss items which have accrued but have not been paid, when debited to Loss and Gain Account are through the credit side of entry established as liabilities as to the future, and must so show on the Balance Sheets until liquidated. The payments made in advance on account of expenses, when credited to Loss and Gain Account are through the debit side of the entry established as assets and must so show on the Balance Sheets until liquidated.

I have selected the case of taxes by which to explain this principle.

In the classification book referred to, the account "Taxes" appears among the operating accounts; the account "Advance Taxes" appears among the advance payment accounts; the account "Accrued Taxes" appears among the accrued accounts.

I now quote from the classification book referred to:

TAXES

This account is intended to show the amount of taxes, whether paid, due and not paid, or accrued but not due, applicable to the elapsed period of the current fiscal year.

Taxes—City, County and State.

To keep this account accurately, it is necessary to ascertain the specific twelve months for which each class of taxes is assessed and levied. If the period covered by tax levy corresponds with the fiscal year of the company, and the taxes are paid at the beginning of the period for which such levy is made, the amount when paid should be charged to "Advance Taxes"; but if the taxes are due and payable at the end of the period for which such levy is made, the amount when paid should be charged to "Accrued Taxes."

If the period covered by any tax does not correspond with the fiscal year of the company, the amount of the tax when paid should be divided between "Accrued Taxes" and "Advance Taxes" in the proportion applicable to each.

(Payments charged to "Advance Taxes" shall always be for taxes covering a period *subsequent* to the date such payment is made, and payments charged to "Accrued Taxes" shall always be for taxes covering a period *prior* to the date such payment is made.)

Journal entries should be made each month charging "Taxes" and crediting "Advance Taxes" with the proportion (one twelfth) of each class of taxes paid in advance and charging "Taxes" and crediting "Accrued Taxes" with the proportion (one twelfth) of each class of taxes, accrued but not due, based upon the amount shown by the tax rolls, if made up, or if not made up, on an estimated amount based on the previous year's tax or any other reliable data.

Taxes assessed for Improvements to be charged to Real Estate Account (see "Real Estate").

JOURNAL ENTRIES

Taxes,	$000.00	
Advance taxes,		$000.00
For proportion of taxes paid in advance, applicable to the month of ————.		
One twelfth of $.....=.....$.....		
State and County, one twelfth of $.....=$.....		
City and School, one twelfth of $.....=$.....		
Taxes,	$000.00	
Accrued taxes,		$000.00
For estimated taxes accrued, but not due, applicable to the month of ————.		
State and County, one twelfth of $.....=$.....		
City and School, one twelfth of $.....=$.....		

NOTE.—At end of the year close this account (Taxes) into "Loss and Gain."

In the classification book is shown in place of Loss and Gain Account another account into which "Taxes" is closed on its way to Loss and Gain Account; for simplicity, I show it as going direct into "Loss and Gain."

ADVANCE TAXES

This account is intended to show the amount paid for taxes covering a period subsequent to the date such payment is made.

Credit this account and charge Taxes Account each month with proportion of taxes applicable to this month.

See following entry:

Taxes,	$000.00	
Advance taxes,		$000.00

For proportion of taxes paid in advance, applicable to month of ————.
One twelfth of $.....=.....$.....
State and County, one twelfth of $.....=$.....
City and School, one twelfth of $.....=$.....

NOTE.—See "Taxes" for full explanation.

ACCRUED TAXES

This account is intended to show the amount of taxes accrued but not due, covering a prior period. The balance of this account will at all times show the accrued liability for taxes.

Credit this account and charge Taxes Account each month with estimated amount of taxes accrued, but not yet due or payable—estimate to be based on previous year's tax bills, unless accurate method of estimating for current year can be arrived at. See the following entry:

Taxes,	$000.00	
Accrued taxes,		$000.00

For estimated taxes accrued, but not due, applicable to month of ————.
State and County, one twelfth of $.....=$.....
City and School, one twelfth of $.....=$.....

NOTE.—See "Taxes" for full explanation.

The explanations as contained in these three pages of the classification book would be all-sufficient for one familiar with accounts.

But I have found that you are not able from these descriptions to understand fully all the accounting steps to be taken in connection with taxes. I will therefore go into this matter in some detail with the purpose of explaining directly this particular case and incidentally advance payments and accrued accounts in general.

First, turn back and read again the note in parenthesis as quoted from the classification book under the head of "Taxes."

Remember, then, that "Taxes" is the only one of the three which is an expense or a loss account. "Advance Taxes" is an asset account, and "Accrued Taxes" is a liability account.

Now note that in both the journal entries, "Taxes Dr. to Advance Taxes" and "Taxes Dr. to Accrued Taxes," the account "Taxes" is debited with one twelfth of the total yearly payment for taxes. Thus all the debits for taxes are made through the journal and when the cash is actually paid cash will be credited and the debit must be made against some other account than "Taxes" or we should have this expense or loss account debited twice with the same amount paid.

If a tax bill is paid, part of which applies to a period subsequent to the date of payment, that part will be debited to "Advance Taxes." Then the *debit* balance of this account will represent an asset, the asset being reduced monthly by the journal entry:

	DR.	CR.
Taxes,	$000.00	
Advance taxes,		$000.00

Here the cash transaction, and hence the cash entry *precedes* the journal entry.

In the case of taxes paid after the liability has accrued, the journal entry

Taxes,	$000.00	
Accrued taxes,		$000.00

precedes the cash entry.

The balance so built up to the *credit* of "Accrued Taxes" represents a liability.

Later, when the cash is paid, cash will be credited, and so much of the cash payment as is applicable to periods prior to the payment will be *debited* to "Accrued Taxes," wiping out the liability balance built up by the journal entries which preceded the cash entry.

It is, then, to be particularly noted that in the case of "Advance Taxes" the cash entry precedes the journal entry, and in

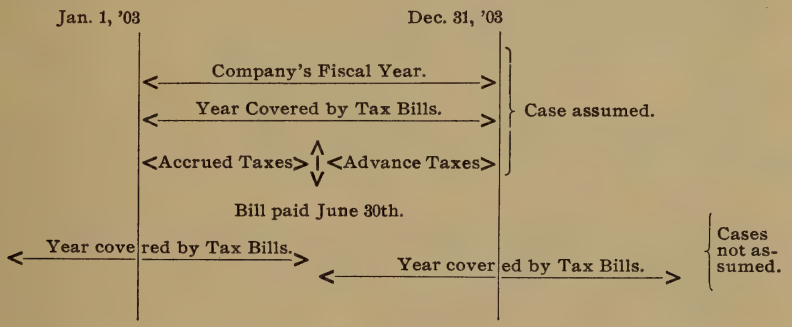
the case of "Accrued Taxes" the journal entry precedes the cash entry.

In the first case an asset balance is set up by the payment of cash in advance, and in the second case a liability balance is set up by the charging up monthly to "Taxes" (a loss and gain account) the amounts for which the business has become liable, but for which the date of payment has not yet arrived.

Let us take a fairly simple case and follow through the necessary journal and cash entries.

We will assume that the several tax bills cover the same year and that this year and the company's fiscal year coincide, and that the tax bills are paid June 30 of each year.

To make sure that I am understood, I give the following diagram:



The last two cases might be further varied by showing more or less of the tax year prior to January 1/03 (to the left of the January 1 vertical line) or by showing more or less subsequent to December 31/03 (to the right of the December 31 vertical line).

Further variations could be introduced by indicating different times for the payment of the several tax bills.

In the case we have assumed, when the tax bill is paid June 30, one-half of the payment applies to the prior six months and the other half to the subsequent six months.

Now suppose we are carrying into our ledger accounts each month all items of loss and gain.

Then at the end of each month of the first six months of the year we shall have to employ the journal entry:

	DR.	CR.
Taxes,	$000.00	
Accrued taxes,		$000.00
For estimated taxes accrued, but not due, applicable to month of (January or February or March or April or May or June) being one twelfth of $....., etc.		

By the end of June we shall have a *debit* balance to the loss account, "Taxes," equal to one half of the yearly charge for taxes (provided our estimate was correctly made) and a *credit* balance to "Accrued Taxes" of like amount, showing the liability established in advance of the payment.

Now, according to our assumption, the tax bills are paid June 30.

Then cash is credited for the total amount paid and one half is debited to "Accrued Taxes" and the other half to "Advance Taxes."

The half debited to "Accrued Taxes" wipes out the credit balance which has been built up by the monthly journal entries. This credit balance showed that the business was liable for that amount on account of taxes accrued. But the business, through cash, now pays this accrued liability, and so cash is credited and "Accrued Taxes" is debited, the money having been paid on its account. So the records are now clear as far as Accrued Taxes Account is concerned.

The other half of the cash payment, debited to "Advance Taxes," sets up an asset account. It gives a debit balance to "Advance Taxes," representing money paid out in advance which is to be paid back in service to be rendered by the State, County and City in the way of police protection, fire protection, street cleaning, etc.

This balance to the debit of "Advance Taxes" will be reduced, month by month, by the entry:

	DR.	CR.
Taxes,	$000.00	
Advance taxes,		$000.00

as already explained.

By the end of the year these successive journal entries will wipe out the debit balance of "Advance Taxes."

And so both "Accrued Taxes" and "Advance Taxes" will be balanced and "Taxes" will show a debit balance representing the total amount of taxes for the year.

By this method each month's cost has taken its share of the year's taxes irrespective of any question of time of payment of the tax bills.

But it may be objected that, without employing the journal entries, the Loss and Gain Account for the *year* would have only had to bear the charge for its year's taxes.

That is true in the case assumed, where the tax year and the company's fiscal year coincide, but it would not be so in the other cases more likely to occur. Furthermore, without these journal entries the operating cost would not be shown correctly month by month.

Suppose that the tax year and the date of payment are such that part of the bill paid prior to December 31 applies to the subsequent year. Then, as explained, this portion will be debited "Advance Taxes," cash taking credit for the total amount paid. Then the debit balance to "Advance Taxes" will represent as many twelfths of one year's taxes as there have been months paid in advance. That is, as many twelfths as have not been wiped out by the monthly journal entries "Taxes Dr. to Advance Taxes" made subsequent to the payment of the bill.

This balance to the debtor of "Advance Taxes" will be carried over on the ledger to the next year and will appear in the Balance Sheet of January 1 as an asset.

Now suppose that the tax year and the date of payment are such that at the end of the year there is a certain portion of the year's taxes not paid. The liability has accrued but the

bill to include these months will not be due and payable until some time in the company's next fiscal year.

Then we shall have a credit balance to "Accrued Taxes" built up by the monthly journal entries "Taxes Dr. to Accrued Taxes," representing a liability for so many twelfths of the year's taxes as there are months accrued.

This balance to the credit of "Accrued Taxes" will be carried over on the ledger to the next year and will appear in the Balance Sheet of January 1 as a liability. As already explained, when during the subsequent year, the tax bill is paid, cash will be credited for the total amount and "Accrued Taxes" will be debited for an amount equal to the credit balance, which balance will include the amount brought over from the previous year.

To illustrate further that "Accrued Taxes" and "Advance Taxes" appearing in the Balance Sheet of January 1 will represent a liability and an asset respectively, we may consider how cash will be influenced by these accounts. Suppose there is carried over to the next year a certain balance to credit of accrued taxes; this indicates that taxes which have accrued and been charged to tax account as part of the year's expense have not been paid and therefore the cash on hand as indicated by the debtor balance of Cash Account is that much larger than it would have been if this debt of the year had been paid. Hence we must show a liability to offset the additional cash on hand by reason of this debt.

On the other hand, suppose we have paid taxes in advance for a number of months of the next year, then a certain amount will have been taken out of cash on account of next year and the asset cash will be correspondingly reduced. But the condition of the business as of January 1 is the same as though the cash had not been paid in advance, therefore the reduction of the asset cash is made good by the equivalent asset of advance taxes.

I have been asked, What happens if the estimate we make for the entry, "Taxes Dr. to Accrued Taxes," is not correct? In this, as in many other instances, we have to base our journal entries on estimate. Here comes in the judgment of the man

of business and here, in many cases, must come in the judgment of the engineer. In case of a mistake, the correction must be made by journal entry to correspond with the facts.

These steps in connection with taxes, if carefully followed through, will show that by the double-entry system of bookkeeping we can make the accounts for each period show, with reasonable accuracy, the period's proportion of all items of loss and gain and all assets and liabilities. It will be seen that if we guided ourselves only by the entries made to show cash received and cash disbursed, this would not be the case. The transfer of cash is only one feature of a commercial transaction, and in some transactions cash is not transferred at any time.

Printed Forms

A scheme of accounting which has to do with a business of any magnitude should provide for a minimum of clerical labor by the use of all available mechanical aids, such as machines for computing, receipting of vouchers, and the like; also printed forms or blanks, bound and unbound, to meet cases of the same general character. Manifestly, it would be absurd to have a printed form or blank for such cases occurring only at long intervals; but it would be equally as absurd to write out in each case all the words and figures of a record, communication, or report if a considerable portion thereof might preferably follow an established form.

There are many advantages in such a system of printed forms or blanks; I will mention four which occur to me at once.

1. It lightens the labors and saves the time of those engaged in the detail work.

2. It serves to remind the writer what information is required. This is particularly important, because the memory cannot be relied upon safely in the press of business.

3. It presents the information in conformity with a uniform practice, so greatly reducing the labor of analysis and comparison on the part of those for whom it is intended.

4. It furnishes the opportunity for a simpler and more easily operated system of filing,—one of the most important features of a large and complicated business. Only those who have prac-

tical experience in the conduct of affairs can appreciate the woful waste of time and energy and the paralysis of useful effort occasioned by the absence of an adequate and well-balanced filing system; though here unnecessary complication is quite as much to be dreaded as insufficiency of system. And many of those who have had this experience fail to estimate correctly the magnitude of the loss in efficiency due to inability to locate data which should be available at once and without specific effort.

For these and other reasons much saving of labor and greatly increased efficiency can be obtained through a well-developed, common-sense system of printed forms.

Outside of accounting, blank forms can be used to great advantage, insuring greatly increased efficiency in performance and providing accurate records for future reference.

I say outside of accounting, but it is to be remembered that many of these records which never come under the eye of the accountant and which are prepared by men ignorant of accountancy, serve as the ground work for much of the accountant's work. I will refer to only one case, which, no doubt, is more or less familiar to all of you and for that reason serves all the better by way of illustration.

Railroads have to do with an immense amount of detail in their several departments, and especially in the operating department. Blank forms, in great variety, are employed to facilitate prompt and accurate action and the maintenance of correct records. It can be seen that especially in the case of instructions to be sent over a wire it is important the messages should be conveyed with absolute accuracy and at the minimum expenditure of time. The instructions must be condensed as far as possible without sacrificing clearness and explicitness.

Take, for instance, a wreck. The conductor must get the news to the proper officials without delay. If he had to write out every word required to make a correct and comprehensive report, he would have to write many minutes longer than when using a blank form, and there would thus be an unnecessary delay in conveying the information to the officials from whom instructions and assistance are required. Furthermore, at such

a time of mental stress, his memory could not be relied upon, for we know that memory cannot be depended upon even under normal conditions.

To meet this emergency a blank is used which has spaces for every item of information which past experience has suggested. Opposite each of these spaces are certain words which ask a direct question, and in each case the question is indicated by a cypher, either a letter or a number. The conductor of the train which has been involved in the accident proceeds to the nearest telegraph station on his line and calls for this blank form, "Accident Report by Telegraph." He fills in the blank spaces as required and, as I have said, he is thus reminded of each item of information which the official to whom he is reporting will require of him. As soon as the blank is filled up, the operator calls for the operator at the other end of the line and tells him to provide himself with "Accident Report by Telegraph" blank. The operator at the scene of the accident then gives the cypher for the first blank space, followed by the information which the conductor has filled in; and so he goes down through the whole form and promptly conveys to headquarters the information required to meet the emergency which has arisen. The receiving operator, as soon as he receives the cypher, turns to that space in his blank and fills in all that comes over the wire until the next cypher is signaled.

It can be seen readily that not only does this give the opportunity for headquarters to do everything possible to correct promptly and efficiently the troubles brought about by the accident, but a complete record is furnished which can be referred to with confidence in case of law suits or other complications.

Furthermore, there are other advantages, because such a system, carried out completely, must lead to great saving in the expenditures for wages, and also must lead to reductions in the cost of plant. Take the case just referred to; a single wire would be capable of conveying a much greater volume of information when so much of that information is reduced to cypher form. If the use of telegraph blank forms were confined to reporting wrecks, this item of investment in, and maintenance

of, telegraph plant might be unimportant, because of the comparatively limited number of accidents; but an immense number of blanks are employed for other purposes which require the constant use of the telegraph; namely, the reporting of the movements of cars and their presence at stations; reports of conductors showing the make-up of their trains; reports of freight at various points along the line, etc.

In the operation of a number of properties under one ownership, through a uniform system of accounting, the importance of a well-considered scheme of printed forms can hardly be overestimated. In the collecting of the information required for the permanent statistical records, and for the classifying of items of expenditure for the guidance of the bookkeepers, they are a necessity. Where daily, weekly or monthly reports are rendered by the several outlying stations to the home office, it is essential that these reports should be uniform in arrangement so that comparisons can be made readily between the several reports of each station and the like reports of the several stations. The uniformity in comparisons thus secured in the monthly statements of operating cost, minutely subdivided, is of the utmost value.

But there is a danger in this connection; namely, the danger of going to extremes—a danger always to be feared and avoided. System, overdeveloped, becomes red tape, and that perhaps is to be avoided almost as much as lack of system. A full appreciation of efficiency in performance should precede appreciation of efficiency in the recording of results. If the keeping of the records and the accounting are allowed to obstruct the progress of the business, it is only a question of time when there will be no business to record. The highest attainable efficiency in performance and the most explicit and convenient forms of record should go hand in hand. The keeping of a reasonably complete and detailed set of records helps to increase the profits from a given volume of business and also helps to increase the volume of business. Unless by the records results can be analysed accurately, it is difficult and often impossible to eliminate weaknesses and uneconomical items of management. It is not suffi-

cient to know that the business is profitable as a whole; the results should be known step by step.

In connection with our tremendous development in industrial lines, there is springing up a new business; namely, that of the efficiency engineer, production engineer, engineer accountant, or economy engineer, for these and other titles have been used. Quite a number of our graduates are specialists in this line, and it is not out of place to mention Frederick W. Taylor, Henry L. Gantt and E. R. Douglas. Mr. Taylor's name appears prominently in the present-day discussions of efficiency. Mr. Gantt's lecture on Task and Bonus in Management is included in this volume. Mr. J. Newton Gunn, of Gunn, Richards & Co., is a prominent and most practical worker in this field; and I am indebted to him for the chapter on Costs.

Men to be competent in this line must be well qualified in industrial matters, especially shop practice, and also qualified as accountants. They must be capable of analysing the records and accounts of a business so that they can detect uneconomical steps in shop practice and management; and, having detected such weaknesses, they must be competent to devise methods for improvement. Sometimes these methods of improvement have to do with changes in the system of management or of control, and sometimes they have to do with changes in processes of manufacture. It will, therefore, be seen that the field is an extremely wide one and calls for theoretical ability of a high order, reenforced by wide experience and balanced by good judgment. It by no means follows because a man preaches efficiency that he practices what he preaches.

An efficient system of shop cost records should furnish the means for comparing, month by month, every item of cost. If such an inspection of the records shows that during a certain month a selected item of cost has been increased, at once it is suggested that an investigation should be instituted to learn the cause or causes of this increase. It is only by such continual exercise of competent and vigilant comparisons that the costs of a large business can be kept within competitive limits.

There is constantly an immense waste of time and nerve

force through the lack of well-arranged records, this deficiency making it necessary to "dig out" information which ought to be at hand, complete and ready for use as required. Not only is time thus wasted, but busy men have their burdens immensely increased by the pressure resting upon them through duties unperformed. Often the hardest part of a task is getting the work started, and this because we have not at hand certain data which we have previously developed but which are not now in form for ready reference.

In this connection I may well refer to the advantages of the card system. There are concerns now that make a specialty of working up to order card index schemes for all special cases, supplying not only the cards but also the furniture required to make the scheme complete. I remember the time when a man who adopted the card system had to work up his own scheme, had to have his own material manufactured and then secured a result far inferior to what can now be secured at small expense through the services of experts in that line.

If a card system is adopted for the filing of data collected outside of the office, some systematic scheme must be developed whereby these notes will be passed from time to time into the hands of those responsible for the maintenance of the scheme. One good arrangement which does away with the necessity of doing the work twice is to keep in your pocket a package of cards, of convenient size, the blank cards in one side of a wallet, and those which have been written on in the other side. As it becomes necessary to make a memorandum of data obtained, the information can be filled in on one of these cards and the card then put in with those ready for filing. From time to time the cards containing data can be passed over to the filing clerk and a like number of blank cards placed in the wallet. This arrangement can be supplemented by having envelopes of exactly the same *outside* dimensions as the cards, so that when a newspaper clipping or the like is to be preserved it can be placed in one of these envelopes, and as the envelopes are of the same outside dimensions as the cards, the pack can be manipulated conveniently.

ACCOUNTANCY

Analysis of a Balance Sheet

The ability to analyse a ledger balance sheet is of prime importance to the man who wishes to know for himself the cost of production of any commodity and the condition of a business as a whole as represented by the books of account. This ability is a necessity in the case of one who aspires to a position of leadership in the industrial field. In this brief course we cannot hope to qualify our students to interpret a complex balance sheet, but they can be qualified as to the fundamentals and shown how to profit later most rapidly by study in the school of experience. The man who does not understand the principles of accountancy to the extent of being able to analyse the items of all the accounts involved, must accept the balance sheet on faith.

It by no means follows that a balance sheet, because it shows the complete ledger record, correctly represents the condition of a business.

Nor does it necessarily follow that because the statement of loss and gain is made up correctly as far as the ledger records go, that the statement is complete and correct.

I shall now show how a balance sheet is developed from a trial balance.

I shall consider the simplest possible case—that of a firm, composed of two equal partners, engaged in a merchandising business

The Trial Balance is a statement prepared by taking off from the ledger the debit or credit balance of each open account. The "balance" of each account is found by footing up the debit and credit entries and deducting the smaller sum from the larger; the difference is the "balance." This work is done in pencil, the "balance" being written to the left of the dollars-and-cents column on the side which shows the larger sum. Frequently the trial balance is taken off from the ledger so as to show the debit and credit totals as well as the balances. As the title implies, one reason for taking off the Trial Balance is to prove the ledger—to

find whether the sum of the debit balances equals the sum of the credit balances; if the ledger does not balance, nothing further can be done until the errors are found and a balance obtained.

The Balance Sheet is the statement of the balances of all open accounts after closing the books by consolidating all loss and gain accounts and all loss and gain items in the account called Loss and Gain.

In the example now to be considered it is assumed that the fiscal year is coincident with the calendar year—from January 1 to December 31. First is shown a Trial Balance taken from the ledger at the end of the business, December 31, 1903. If not actually taken off at that time, it is taken off *as of that date*—that is, any transactions which have occurred after that date are not posted into the ledger until the transactions for the year 1903 have been finally adjusted, preparatory to the ledger being re-opened for the year 1904; or, if they have been posted, the work has been so done as not to confuse the entries of 1904 with those of the previous year.

Next is shown the journal entries required to close the books for the year just ended. These entries form the basis for transferring all the loss and gain items and accounts as scattered through the ledger to the one account of Loss and Gain (also known as Profit and Loss), thus obtaining in the one ledger account a balancing of all losses and gains.

One journal entry charges or debits Loss and Gain Account with the debit balance of each loss account or the sum of these, and credits each of these loss accounts with the balance to its debit, thus closing these accounts. For every debit there must be a credit; and as we are transferring the debit balance from each separate account to the one general account, that there may not be a duplication of the debit balance, the separate account must be closed by a credit entry equal in amount to the debit balance. Another journal entry credits Loss and Gain Account with the credit balance of each gain account or the sum of these, and debits each of these gain accounts with the balance to its credit, thus closing these accounts.

Next is shown the Loss and Gain Account as it appears in the

ledger after these two journal entries have been posted. The balance of the Loss and Gain Account now shows the profit for the year, or should do so.

Next comes a third journal entry which debits Loss and Gain Account with the balance found and credits to the personal account of each of the two partners one half of the net profits as indicated by the credit balance of Loss and Gain Account. In the case of a stock corporation this last entry would not be made, but the balance sheet would show the Loss and Gain balance as an undivided profit, the dividends as paid being charged later to this account. Finally is shown the Balance Sheet as taken from the ledger after all the closing journal entries—three, in this simple example—have been posted. The Balance Sheet so obtained will contain the balances of all the accounts remaining open in the ledger. When proved—the sum of the debit balances being found equal to the sum of the credit balances—the accounts are ruled off in ink, and in the case of the open accounts the balances are brought down below the ruling, thus reopening the ledger for the new year.

Ledger Trial Balance

(Showing the debit and credit balances of all accounts in the ledger, taken off *before closing the books for the year;* that is, before carrying into Loss and Gain Account the several loss and gain items of the fiscal year ended December 31, 1903.)

	This column is used to indicate Ledger folios where Accounts have been found	Dr.			Cr.		
Cash		18	675	64			
Advance Interest			650	00			
Interest Receivable			325	45			
Bills Receivable		7	000	00			
Accounts Receivable		6	745	87			
Merchandise Stock		23	874	25			
Phœnix Gas Bonds		2	800	00			
Norfolk and Western R. R. Stock		1	450	00			
Office Furniture and Fixtures		2	184	27			
Real Estate		5	500	00			
Expense General			965	88			
Advertising		2	000	00			
Salaries and Wages		10	600	00			
Salary Bonuses			500	00			
Traveling Expense		5	675	86			
Agents' Commissions		8	764	76			
Discount and Interest			845	65			
Store and Office Expense		4	576	83			
Accounts Not Collectible			785	00			
Merchandise Sales					60	650	24
Erie R. R. Stock						560	40
J. E. Thomas—Personal Account					2	422	63
W. L. Sharp—Personal Account					2	213	36
J. E. Thomas —Capital Account					15	000	00
W. L. Sharp—Capital Account					15	000	00
Interest Payable						465	00
Salaries and Wages Payable						540	00
Accounts Payable					2	567	83
Bills Payable					4	500	00
		103	919	46	103	919	46

JOURNAL

(Closing entries, assumed to be made on page 75, showing the entries made in the journal as a basis for transferring to Loss and Gain Account the several loss and gain items shown separately on the Trial Balance.)

			Dr.	Cr.
19	03			
Dec.	31	Loss and Gain Account, Dr.	35 778 16	
		to Sundry Accounts as below:		
		Expense General		965 88
		Advertising		2 000 00
		Salaries and Wages		10 600 00
		Salary Bonuses		500 00
		Traveling Expenses		5 675 86
		Agents' Commissions		8 764 76
		Discount and Interest		845 65
		Store and Office Expense		4 576 83
		Accounts Not Collectible		785 00
		Merchandise Stock		
		Depreciation 4% on $23874.25		954 97
		Office Furniture and Fixtures		
		Depreciation 5% on $2184.27		109 21
		Closing books for year ended this date by transferring loss items to Loss and Gain Account.		
		Sundry Accounts as below, Dr.		
		to Loss and Gain Account:		61 210 64
		Merchandise Sales	60 650 24	
		Erie R. R. Stock	560 40	
		Closing books for year ended this date by transferring gain items to Loss and Gain Account.		

This column is used to indicate Ledger folios where Accounts have been found

LEDGER

LOSS AND GAIN ACCOUNT

(As the account appears in the ledger *after* posting the two journal entries above and *before* posting the journal entry to follow which indicates the division of profits between the two partners. These postings, as far as Loss and Gain Account is concerned, can be made in detail, as shown, or in one amount on each side as shown in the journal entries, $35,778.16 and $61,210.64, respectively. The expanded form is used here as being more self-explanatory.)

Dr. Cr.

19 03							19 03						
Dec. 31	To Journal	75		965	88		Dec. 31	By Journal	75	60	650	24
	" "	"	2	000	00			" "	"		560	40
	" "	"	10	600	00							
	" "	"		500	00							
	" "	"	5	675	86							
	" "	"	8	764	76							
	" "	"		845	65							
	" "	"	4	576	83							
	" "	"		785	00							
	" "	"		954	97							
	" "	"		109	21							
	To Balance carried down		25	432	48							
			61	210	64					61	210	64
							19 03					
							Dec. 31	By Balance brought down		25	432	48

Journal

(Showing the entry in the journal dividing the profits as indicated by Loss and Gain Account equally between the two partners. Entry is assumed to be made on page 76 of the journal.)

			Dr.			Cr.		
19 03								
Dec.	31	Loss and Gain Account, Dr. to Sundry Accounts as below:	25	432	48			
		J. E. Thomas, Personal Account				12	716	24
		W. L. Sharp, Personal Account				12	716	24
		Dividing between the Partners the profits for the year as shown by "Loss and Gain."						

Ledger

LOSS AND GAIN ACCOUNT

(As the account appears after posting the above journal entry which divides the profits as shown by Loss and Gain Account between the two partners, omitting the details previously shown above the footings.)

Dr.									Cr.							
				61	210	64							61	210	64
19	03						19	03							
Dec.	31	To Journal	76	12	716	24	Dec.	31	By Balance brought down				25	432	48
		" "	"	12	716	24									
				25	432	48							25	432	48

Ledger Balance Sheet

January 1, 1904

(Showing the accounts open in the ledger after posting from the journal all the closing entries and the entry dividing the profits between the two partners, that is, the condition of the ledger when reopened for the business of 1904.)

		Dr.			Cr.		
	Assets:						
	Cash	18	675	64			
	Advance Interest		6	0 00			
	Interest Receivable		325	45			
	Bills Receivable	7	000	00			
	Accounts Receivable	6	745	87			
	Merchandise Stock	22	919	28			
	Phœnix Gas Bonds	2	800	00			
	Norfolk & Western R. R. Stock	1	450	00			
	Office Furniture and Fixtures	2	075	06			
	Real Estate	5	500	00			
	Liabilities:						
	J. E. Thomas—Personal Account				15	138	87
	W. L. Sharp—Personal Account				14	929	60
	J. E. Thomas—Capital Account				15	000	00
	W. L. Sharp—Capital Account				15	000	00
	Interest Payable					465	00
	Salaries and Wages Payable					540	00
	Accounts Payable				2	567	83
	Bills Payable				4	500	00
	This column is used to indicate Ledger folios where Accounts have been found	68	141	30	68	141	30

It is to be understood that the notes in parenthesis beneath the titles of the several statements shown are not part of the entries,

but are introduced as guides by the way. On the other hand, the explanations at the end of the journal entries are parts of those entries, for each entry should be self-explanatory.

The problem now is, How is the Balance Sheet derived from the Trial Balance?

First the rule must be recalled which shows that balances on the left or debit side of the ledger are:

Assets, if they represent moneys to be received or regained.

Losses, if they represent moneys not to be received or regained.

Balances on the right or credit side of the ledger are:

Liabilities, if they represent moneys to be paid or returned.

Gains, if they represent moneys not to be paid or returned.

It is not probable that this rule can be applied to the Trial Balance in the case of every account unless additional information is available, but in the case of many of the accounts the facts can be determined by inspection.

As we examine the Trial Balance, which shows all the asset and loss accounts on the left and all the liability and gain accounts on the right, we find first on the left a number of asset accounts, as they represent moneys which we have the right to believe will be received.

"Cash," $18,675.64, represents money that we can demand from the bank or other depository.

"Advance Interest," $650, represents money that we have paid in advance of December 31, 1903, as interest for money borrowed, and the service we have thus paid for is yet to be received. This represents, then, cash which has been paid in advance to cover one of the losses of the year 1904, and therefore instead of being debited to "Discount and Interest" as one of the losses of 1903, it has been debited temporarily to "Advance Interest." The amount has been borrowed from cash on account of the year 1904. If it represents the interest deducted in the discounting of a note or bill payable, when the note is paid or renewed, no cash will be paid to cover this interest as Cash has already paid it in advance. So the interest item will be covered by a journal entry instead of a cash entry, debiting the amount to "Discount and Interest" as one of the loss items of the year 1904, and crediting it to "Advance

Interest," thus wiping out this asset item, just as that much of the cash item would be wiped out if the interest had not been in advance. The account then represents money borrowed from cash and so is an asset.

"Interest Receivable," $325.45, represents money which will be paid to us later; the amount shown has accrued to our credit up to December 31, but the time for its receipt has not arrived. The amount having been earned during the year 1903 has been credited by journal entry to "Discount and Interest" as one of the gains of the year and debited to "Interest Receivable," which represents the money earned but not yet received. When received it will be debited to cash and credited to "Interest Receivable" instead of to "Discount and Interest," so wiping out "Interest Receivable" as an asset and increasing Cash as an asset to a like amount. Thus it does not appear again as a gain item, as it already has been included as one of the gains of 1903. The account then represents an asset.

"Bills Receivable," $7,000.00, represents notes given to us in lieu of cash. If received for merchandise, the entries have been made in the journal debiting "Bills Receivable," instead of Cash, and crediting "Merchandise Sales." When the notes are paid, "Cash" will be debited and "Bills Receivable" credited. "Merchandise Sales" will not be credited then because that account was paid by a note instead of cash and received its credit at that time. The account then represents cash to be received and so is an asset.

"Accounts Receivable," $6,745.87, represents merchandise which has been delivered but for which neither cash nor notes has been received. To get the facts on the books and to represent the transactions of the year 1903 in full, the amount due on these bills rendered for merchandise sold and delivered, journal entries have been made debiting "Accounts Receivable" and crediting "Merchandise Sales." Thus the profits on these sales are represented in Merchandise Sales Account although the cash has not yet been received. The account then represents money due on account of merchandise sold and so is an asset. This would be equally true if it represented services sold.

"Merchandise Stock," $23,874.25, represents the cost of the

merchandise in stock and yet unsold. Before deciding that this is an asset to the full amount shown on the ledger, the merchandise must be inventoried and appraised to determine its present market cost as compared with like merchandise which could be purchased or manufactured. This is a question at times most difficult to solve, and so necessarily great care is required in making the inventories and appraising the merchandise. The result is at the best an estimate based upon expert opinion. Here is the element of speculation which forces its way into all classes of business. The first journal entry shows that in this case I have assumed that in "Merchandise Stock" there is a depreciation or deterioration of 4 per cent and so $954.97, as 4 per cent of $23,874.25, has been counted as a loss, reducing the asset to $22,919.28. This account well represents how an asset account can be found to be in part also a loss account. The same question arises as to all asset accounts; even Cash might represent wholly or in part a loss by the failure of the bank in which the cash is deposited. But in our account keeping we must be governed by the probabilities, always being careful to keep on the safe side.

"Phœnix Gas Bonds," $2,800.00, represents money invested in the securities named which have been purchased or accepted in trade. The fact that we allow the bonds to be carried on the books at $2,800.00 should mean that they can be sold for at least that amount. Evidently an asset.

"Norfolk & Western Railroad Stock," $1,450.00. Same case as Phœnix Gas Bonds account. Evidently an asset.

"Office Furniture and Fixtures," $2,184.27. Similar to the case of "Merchandise Stock." Particularly in the case of furniture and fixtures it is good practice to depreciate liberally as this is an asset which, as second-hand material, can be sold only at a considerable discount, although its actual value for service may be unreduced. In this case I have assumed a depreciation of 5 per cent, and so 5 per cent of $2,184,27 has been counted as a loss, reducing the asset to $2,075.06.

"Real Estate," $5,500.00, represents money invested in real estate which has been purchased for occupancy or accepted in trade. Evidently an asset.

We now come to debit balances which by their titles indicate that they are loss accounts.

"Expense General," $965.88, shows by its title that it carries certain of the expenses of the business as indicated by the particular scheme of classification.

"Advertising," $2,000.00, needs no explanation to show that it is a loss account or to show the nature of the items covered.

"Salaries and Wages," $10,600.00, loss account, self-explanatory.

"Salary Bonuses," $500.00, loss account, indicates an account into which are charged items of extra salary allowances based upon the results secured.

"Traveling Expenses," $5,675.86, loss account, self-explanatory.

"Agents' Commissions," $8,764.76, loss account, self-explanatory.

"Discount and Interest," $845.65. This is intended to indicate an account into which interest as a loss is debited and interest as a gain is credited. For instance, in the case of "Advance Interest," as already explained, "Discount and Interest" will be debited in 1904 when the asset of 1903, "Advance Interest," is transformed into the loss of 1904. Also in the case of "Interest Receivable," as already explained, the interest earned for the year 1903 but not paid until the next year, was by journal entry credited to "Discount and Interest" when charged to "Interest Receivable." Taking the cases of interest paid on borrowings and received on lendings, the transactions being wholly within the year 1903 and so cash transactions, the interest paid would be debited to "Discount and Interest" and credited to "Cash," and the interest received would be credited to "Discount and Interest" and debited to Cash. The amount to the debit of "Discount and Interest" shows that during the year 1903 the interest debits have exceeded the interest credits in the amount of $845.65.

"Store and Office Expense," $4,576.83, indicates by its title that it is a loss account. Exactly what items of expense should be charged depends upon the particular scheme of classification.

"Accounts not Collectible," $785.00. Frequently styled "Bad Accounts" or "Bad Bills." The debit balance to this account indi-

cates that a careful scrutiny of "Accounts Receivable" has shown that certain amounts applicable to the year 1903, which had been debited to "Accounts Receivable," as before explained, we know or believe will not be received,—the accounts are "bad,"—and so, by journal entries made before the closing entries, "Accounts not Collectible" has been debited and "Accounts Receivable" has been credited. Another instance of an asset being transformed in part to a loss.

We now come to the accounts on the right or credit side of the Trial Balance.

"Merchandise Sales," $60,650.24. This account has been debited with the *cost* of all the merchandise *sold* and credited with the receipts from these sales, whether the payment has been made in cash, notes, or only charged to "Accounts Receivable" as already explained. The cost of merchandise not yet sold is carried as an esset in "Merchandise Stock" as already explained. The balance to the credit of "Merchandise Sales" then represents the gross profits from the trading in merchandise, and so is a gain account.

"Erie Railroad Stock," $560.40. This is included to represent a profit made in the purchase and sale of a certain number of shares of Erie Railroad stock. When the stock was purchased, the amount paid was credited to "Cash" and debited to "Erie Railroad Stock." When the stock was sold, the amount received was debited to "Cash" and credited to "Erie Railroad Stock," and the amount received being $560.40 in excess of the amount paid, left a credit balance of this amount. This, then, is a gain account.

We now come to the remainder of the credit accounts, all of which will be found to represent liabilities.

J. E. Thomas, personal, $2,422.63.

W. L. Sharp, personal, $2,213.36.

Represent the amounts owing by the firm as a whole to the partners as individuals, and therefore represent liabilities. These accounts are sometimes known as "Drawing Accounts" as from these accounts the partners draw their profits, as distinguished from the partners' Capital Accounts, which should always show the amount of capital invested in the business by each partner.

These personal accounts show that Thomas has to his credit accumulated profits of $2,422.63, and Sharp $2,213.36.

"J. E. Thomas, Capital," $15,000.

"W. L. Sharp, Capital," $15,000.

These accounts show that each partner has put $15,000 into the business and that the business as a whole owes to each partner $15,000. These accounts then represent liabilities.

"Interest Payable," $465.00. Represents a condition exactly opposite to that of "Interest Receivable." Interest has accrued against the firm on account of the year 1903, though the payment will not have to be made until the loan is paid some time in 1904. To get the item included in the losses of the year, a journal entry has been made debiting "Discount and Interest" and crediting "Interest Payable" with the interest accrued up to December 31, 1903, inclusive. Thus the loss is represented in "Discount and Interest," and as the loss has not yet been paid it is shown as a liability by crediting to "Interest Payable." When the interest is paid in 1904, "Cash" will be credited and "Interest Payable" will be debited, the loss account of "Discount and Interest" having already been debited in showing the losses of 1903.

"Salaries and Wages Payable," $540.00. The reasoning is the same as in the preceding item. By journal entry "Salaries and Wages" has been debited with the salaries and wages accrued but not due, and "Salaries and Wages Payable" has been credited. Thus the amount is included in "Salaries and Wages" as one of the losses of the year 1903 and, as a credit to "Salaries and Wages Payable," is shown as a liability.

"Accounts Payable," $2,567.83, represents accounts rendered against the firm, say for merchandise purchased, and so represents a condition exactly opposite to that of "Accounts Receivable." In this case, the amount has been covered by journal entry or entries, debiting "Merchandise Stock" and crediting "Accounts Payable." When the several accounts are paid, "Cash" will be credited and "Accounts Payable" debited. Thus "Accounts Payable" (liability account) and "Cash" (asset account) will be reduced by a like amount.

"Bills Payable," $4,500.00. The same explanation as for

"Accounts Payable," except the merchandise has been settled for by the giving of a note or notes. The exact opposite of the condition represented by "Bills Receivable."

With the help of these remarks on each of the accounts shown on the trial balance, the journal entries can be understood readily. Posting each of the credit items of the first entry balances each of the loss accounts and also reduces the debit balance of "Merchandise Stock" and of "Office Furniture and Fixtures"; and posting the debit items to the debit of Loss and Gain Account, carries these losses into this account. Posting the debit items of the second journal entry balances each of the gains accounts; and posting the credit items to the credit of Loss and Gain Account carries these gains into that account.

Thus all the losses and gains of the year have been consolidated in the one account, and the separate accounts representing losses and gains have been closed for the time, to be re-opened with the commencement of the next year's business, to record in detail the losses and gains of the year 1904.

It will now be seen that the Balance Sheet, taken from the ledger after thus closing the books for 1903, only shows asset and liability accounts. It is here to be understood that the credit balance of loss and gain, whether divided to the partners or not by subsequent entry, represents a liability to the partners or owners of the business.

The case I have taken as an example is a very simple one.

It can be seen readily that, in a manufacturing business, the accounting and bookkeeping complications are far greater.

In the case of a large manufacturing concern it would be necessary to keep the books so that all steps in each branch of manufacture would be clearly represented in the accounts. To this end the accounts should be divided and subdivided so that the items of cost would be classified to correspond to the proposed analysis of costs. A scheme of classification which thus multiplies the number of accounts to provide the means for ready and accurate analysis of costs may be considered complicated and burdensome by the bookkeeping department, and is frequently objected to by bookkeepers on that score. It is then to be remembered that in

the case of a large business it pays to so increase the labor and expense of the bookkeeping department provided the manager and his assistants are thus provided with the facilities for keeping themselves constantly informed in the minutest detail of the cost of operation and provided they avail themselves of these opportunities. For a concern doing a large and diversified business nothing could be more inadequate than a condensed classification of accounts, for the analysis of costs could then be effected only by picking out of these condensed accounts, item by item, the information required.

Only by the development of a completely adequate scheme of classification and the rigid adherence to the scheme in the daily work can the records of the business be placed before the management in a form to be relied upon, and without this, economy in operation cannot be assured.

In discussing the classification of transactions and grouping of accounts I have shown another form of balance sheet based upon the equation:

$$\text{Assets} = \text{Liabilities} + \text{Proprietorship}$$

or

$$\text{Assets} - \text{Liabilities} = \text{Proprietorship}.$$

For greater convenience, I now repeat this form:

Assets:		Liabilities:	
.....	$.....	.....	$.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	Total Liabilities:	
.....	.....	Proprietorship:	
.....	.....	.....	.....
.....	.....	.....	.....
		.....	.....
		.....	.....
Equal Total:	$.....	Equal Total:	$.....

To complete my discussion of this subject I include a Trial Balance, Balance Sheet and Profit and Loss Account (Loss and Gain) particularly recommended by Mr. J. Newton Gunn of the firm of Gunn, Richards & Co. Mr. Gunn has also been good enough to give an explanation of these forms and his reasons for adopting them.

By reason of the instruction already received you are now expected to understand how the Balance Sheet and Profit and Loss Account are produced from the Trial Balance. Two points I draw to your attention.

In the Balance Sheet and Profit and Loss Account, for greater convenience, the debits and credits are shown in the same column, the separation being effected by the headings employed.

And the Profit and Loss Account is shown for the month of June in addition to the year ending June 30.

The Balance Sheet

A Trial Balance taken from the private ledger of a small manufacturing company is shown below.

A Balance Sheet and Loss and Gain Account of this same company is shown in order to make clear the essential difference between a Trial Balance and a Balance Sheet.

A Balance Sheet is an orderly presentation of the accounts of a company or undertaking to present to its executives, its shareholders, or creditors, its financial condition.

A great difference of opinion exists between accountants and executives as to the best way of presenting the essential points in the finances of an undertaking.

A Balance Sheet has been prepared from a Trial Balance first given in a form which is believed to represent the best modern practice, to facilitate reference to the several accounts.

Numbers of the accounts have been annexed, namely A1, A2, B1, B2, etc., to facilitate reference only.

The assets or resources of the corporation have been arranged in order of availability in case of liquidation or for its ordinary operation. Its liabilities or debts have been arranged in the order in which these obligations must be met in point of law, or probable necessity of payment in event of liquidation.

TRIAL BALANCE

June 30, 1911

Cash,	$ 3,500 00	
Accounts Receivable—Customers,	14,000 00	
Accounts Receivable—Personal,	500 00	
Notes Receivable,	2,000 00	
Supplies,	2,000 00	
Material,	8,000 00	
Product in Process,	15,000 00	
Finished Product,	5,000 00	
Real Estate,	6,000 00	
Buildings,	14,000 00	
Machinery and Tools,	3,000 00	
Patterns and Drawings,	1,000 00	
Furniture and Fixtures,	500 00	
Patents,	4,500 00	
Good will,	20.000 00	
Advanced Expenses,	1,000 00	
Accounts Payable—Pay Roll,		$1,500 00
" " Purchase Creditors,		7,500 00
" " Personal,		500 00
Notes Payable,		6,000 00
Reserve for Bad Debts,		700 00
" " Buildings,		1,400 00
" " Machinery and Tools,		800 00
" " Patterns and Drawings,		400 00
" " Furniture and Fixtures,		200 00
Capital Stock,		50,000 00
Surplus,		26,400 00
Sales—Lathes,		40,000 00
" Drills,		25,000 00
" Accessory Tools,		15,000 00
Costs—Lathes,	$28,000 00	
" Drills,	20,000 00	
" Accessory Tools,	12,000 00	
Cash Discounts,		2,600 00
Rentals Received,		2,000 00
Administrative Expense,	12,000 00	
Selling Expense,	8,000 00	
Total,	$180,000 00	$180,000 00

BALANCE SHEET. DATE June 30, 1911.

	ASSETS.	Amounts	LAST MONTH		LAST YEAR	
			Increase	Decrease	Increase	Decrease
	Current:					
A-1	Cash	3,500 00				1,500 00
	Accounts Receivable:—					
A-2	Customers	14,000 00				2,000 00
A-3	Other (Personal)	500 00				200 00
A-4	Notes Receivable	2,000 00			500 00	
	Total	20,000 00			500 00	3,700 00
	Inventory:					
B-1	Supplies	2,000 00			100 00	
B-2	Material	8,000 00			3,000 00	
B-3	Product in Process	15,000 00			2,650 00	
B-4	Finished Product	5,000 00				800 00
	Total Inventory					
	Total Current	30,000 00			5,750 00	800 00
	Fixed and Deferred:					
C-1	Real Estate	6,000 00				
C-2	Buildings	14,000 00			2,500 00	
C-3	Machinery and Tools	3,000 00			200 00	
C-4	Patterns and Drawings	1,000 00			200 00	
C-5	Furniture and Fixtures	500 00				
C-6	Patents	4,500 00				1,500 00
C-7	Good will	20.000 00				
C-8	Advanced Expenses	1,000 00			500 00	
	Total Fixed and Deferred	50,000 00			3,400 00	1,500 00
	Total Assets	100,000 00			9,650 00	6,000 00

BALANCE SHEET. (Continued) DATE June 30, 1911.

	LIABILITIES.	Amounts	LAST MONTH		LAST YEAR	
			Increase	Decrease	Increase	Decrease
	Current:					
	Accounts Payable					
D-1	Pay Roll	1,500 00			300 00	
D-2	Purchase Creditors	7,500 00			1,500 00	
D-3	Personal	500 00			500 00	
D-4	Notes Payable	6,000 00				4,000 00
	Total Current	15,500 00			2,300 00	4,000 00
	Reserves:					
E-1	Bad Debts	700 00				
	Depreciations:—					
E-2	Buildings	1,40 00			400 00	
E-3	Machinery and Tools	800 00			200 00	
E-4	Patterns and Drawings	400 00			100 00	
E-5	Furniture and Fixtures	200 00			50 00	
	Total Reserves	3,500 00			750 00	
	Capital and Surplus:					
F-1	Capital Stock	50,000 00				
F-2	Surplus	31,000 00			4,600 00	
	Total Capital and Surplus	81,000 00			4,600 00	
	Total Liabilities	100,000 00			7,650 00	4,000 00

TRADING AND PROFIT AND LOSS ACCOUNT. DATE June 30, 1911.

	SALES.	Month of June, 1911	SAME MONTH LAST YEAR Increase	SAME MONTH LAST YEAR Decrease	12 Months to Date	SAME PERIOD LAST YEAR Increase	SAME PERIOD LAST YEAR Decrease
G-1	Lathes	3,100 00			40,000 00		
G-2	Drills	1,850 00			25,000 00		
G-3	Accessory Tools	1,050 00			15,000 00		
	Total Sales	6,000 00			80,000 00		
	Costs:						
H-1	Lathes	2,200 00			28,000 00		
H-2	Drills	1,480 00			20,000 00		
H-3	Accessory Tools	730 00			12,000 00		
	Total Costs	4,410 00			60,000 00		
	Gross Profit from Operation	1,590 00			20,000 00		
	Other Revenue:						
G-4	Cash Discounts	185 00			2,600 00		
G-5	Rentals Received	166 66			2,000 00		
	Total other Revenue	351 66			4,600 00		
	Gross Profit	1,941 66			24,600 00		
	Commercial Expense:						
J -1	Administrative	1,090 00			12,000 00		
J -2	Selling	730 00			8,000 00		
	Total Commercial Expense	1,820 00			20,000 00		
K	Net Profit	121 66			4,600 00		

DEPRECIATION

Theoretical or Estimated Accruing Depreciation

The Century Dictionary defines depreciation as

1. The act of lessening or bringing down price or value.
2. A fall in value; reduction of worth.

In accountancy the term depreciation is generally employed with reference to plant. In that connection it may be defined as that reduction in worth caused by wear and tear through use, obsolescence, and inadequacy. Unfortunately the term is used loosely at times by accountants and frequently so by others. This is the more to be regretted because at the best the questions involved in the subject of depreciation are most difficult of solution.

A common source of confusion is the failure to recognize that as "depreciation" is reduction in worth or value, "repairs," "renewals," and "replacements" are things done to repair or compensate for the losses occasioned by depreciation.

The repairs, renewals, and replacements currently made may be of such volume and cost as to equal the loss by depreciation, and so protect the original investment. Thus, in paying for repairs, renewals, and replacements, we are in effect paying for depreciation.

In studying the difficult questions involved in depreciation, first the facts are to be determined as accurately as is possible *under the conditions found;* then the necessary assumptions should be made and clearly set forth; and, finally, the methods of accounting to meet these facts and assumptions are to be developed. As in all matters of business and industrial management, the accounting should be subordinated to the matter to be recorded. This is a warning which some accountants need to be reminded of constantly.

Another most serious source of confusion and error is the failure to recognize that the estimating in advance of the facts

the probable and possible future depreciation as the result of obsolescence, inadequacy, and physical decay, to be included as one of the annual items of operating cost, is a distinctly different proposition from determining the actual depreciation which is found in the appraisal of a plant in operation.

The first is sometimes differentiated as theoretical depreciation and the latter as absolute or actual depreciation. Certainly the term "theoretical" is particularly appropriate to the first class of depreciation even if the term "absolute" is not so completely appropriate to the second.

That there is this distinction is a matter which the engineer-student needs to appreciate at the very beginning of his study of this complex subject, particularly as courts, commissions, and some individuals who assume to speak with authority, seem at times to be almost or quite incapable of recognizing any difference.

In the first case,—theoretical depreciation,—we are endeavoring to look into the future in the effort to determine what is to be the useful life of each part of the plant under consideration.

In the second case,—absolute or actual depreciation,—we have the facts as to the present condition of the plant, including obsolescence, inadequacy, and physical decay, open to us by inspection.

I shall first consider theoretical depreciation at some length; and I shall not hesitate to repeat myself if, by so doing, I can approach the discussion from different points of view. From what has already been said, it is apparent that I assume that depreciation is to be treated as an item of annual loss and so to be paid for out of income. But I do not assume that this disposition of depreciation is to be accepted simply on my statement to that effect, for I have found that engineer-students (not to speak of others who have had the advantages of practical experience) find it difficult to understand why depreciation should be so treated.

Unless depreciation of plant, or of any property in which capital is invested, is recognized as an item of loss and hence is treated as a charge against income, necessarily the capital must be impaired to the extent of this "reduction of worth."

Suppose a young man without capital is desirous of engaging in a business requiring capital—say trading in pumps. A friend offers to supply the capital at a certain rate of interest. The young man buys 100 pumps and commences to make sales. As the pumps are paid for, the money is turned in to the young man's cash account, and as demands are made upon his private purse, he meets these demands with this money—the total proceeds of his sales.

The stock of pumps he does not renew.

It certainly requires no argument in this case to show that he has spent the profits from the sale of the pumps and also the principal intrusted to him by his friend.

Following this line of thought, it can be seen that each time a pump is sold not only must another pump be bought to replace the one sold, or enough money be set aside for this purpose, but before claiming any profit on the transaction, there must also be set aside out of the proceeds from the sale enough to pay the pro rata of the year's expenses and of the year's interest to be paid to his friend for the use of capital.

If 100 pumps, alike in character and cost, are sold during the year, then before a profit can be claimed there must be deducted from the proceeds of each pump the original cost of the pumps, plus one one-hundredth of the year's expense plus one one-hundredth of the year's interest.

It must be apparent after a moment's thought that it is just as necessary for the manufacturer to maintain, out of his income, the full value of his plant as covered by capital investment as it is for the tradesman to keep up his stock of merchandise. This is such a self-evident proposition that it hardly seems worth while to bring it to the attention of a class of intelligent men. But it is because this self-evident proposition is lost sight of in accounting, that certain failures have occurred in the industrial field.

Probably you are all familiar with the fact that in properly conducted concerns engaged in trade—large and small—before they make up their statements to cover the results of the year's business, they have to take stock, as it is called; that is, they have to go through their stores and warehouses, carefully inventorying

everything that is on hand, determining whether the articles have depreciated in value, and so finally arriving at as correct an estimate of the *present* value of the stock in hand as is possible. If the present cost to manufacture or purchase proves to be less than the cost as shown by the books of account, *the difference (namely depreciation) must be charged up as one of the items of loss for the year.*

This shows that constant care and vigilance must be exercised by the accountant or bookkeeper to insure the complete separation of the capital or investment items from the income or expense items. In the case of an industrial undertaking this matter should not be left to an accountant and still less to a bookkeeper; for even an accountant is not qualified necessarily to decide many of the questions as to classification of items and especially those involved in the distinction between extensions or betterments and repairs or maintenance of plant. Frequently a nice discrimination is here necessary. In deciding all such questions the conservative manager should give the benefit of the doubt to his investment accounts and so charge all debatable items to repairs or maintenance.

To institute and maintain a scheme of cost keeping, minutely subdivided as to the several departments of manufacture, sales, and administration, for any degree of accuracy in results, requires thorough supervision and coöperation on the part of all department heads. No accountant unaided can secure this accuracy, and without it we are helpless in our efforts to obtain efficiency and economy of operation. The manager of the plant must, therefore, finally be responsible for the accounting.

Let us now consider in some detail how a plant depreciates. This depreciation may be divided into three classes:

1. Certain minor parts of the plant break, wear, or become so inefficient that they have to be repaired or replaced by new parts. These repairs and replacements are paid for out of current income and should be charged up as part of the expenses of the year in which they occur unless they are covered by an inclusive yearly charge estimated to cover all repairs, renewals, and depreciation, as later to be explained.

2. Certain parts, greater in value, break down or become inefficient and they have to be replaced by new parts. These replacements may be paid for out of current income and charged up directly as part of the expenses of the year in which they occur, or the cost may be distributed over a number of years according to the number of years the replaced part has done duty; or they can be included in an inclusive yearly charge as referred to in connection with No. 3.

3. But even when all the repairs and replacements as covered in 1 and 2 are made, the plant as a whole is not necessarily maintained at its original value, even though it may be from time to time thus restored to its original efficiency as far as possible. In spite of these efforts to maintain the plant at par value, it will gradually age, and there is also the liability of its becoming obsolete as to efficiency or inadequate as to capacity.

We, therefore, have to consider the questions involved in the final renewal of the plant; and this accruing liability, which finally must be paid for out of income, and so is one of the loss items, is what is generally known in accountancy as "depreciation," and distinctively as theoretical depreciation.

This final renewal of plant, which we assume may be made necessary by obsolescence, inadequacy, or physical decay, is generally spoken of as if the plant were to be rebuilt as a whole at some time in the future; but such would occur only as the result of some extra hazard and so is not provided for in the estimate of depreciation. Herein is to be found the cause of much of the confusion in the minds of some who have discussed this subject.

In looking into the future, in the effort to estimate the annual loss to accrue through "depreciation," the several parts of the plant will be accorded widely varying expectations-of-life. I shall later explain how the total depreciation is to be estimated by grouping the several parts of plant under their respective expectations-of-life.

If we are to keep intact that part of our capital which is invested in the plant, we must pay from earnings for the repairs and replacements mentioned under Class 1; and for the more

serious replacements mentioned under Class 2; and finally for the "depreciation" described under Class 3.

Having admitted that all maintenance and depreciation charges must be met from income, it remains to be determined how these losses shall be paid.

If all the payments made for repairs, replacements, and final renewal of plant were to be charged against the earnings of the years in which these payments were made, the annual profits would show a wide variation.

Furthermore, if the earnings of any one year, or even the average for a limited number of years, were taken as indicating the *rate of profit,* the result might and probably would be most misleading. The proprietors of any business cannot afford so to deceive themselves. Public utility corporations, subject to the rate making powers of public service commissions, for the protection of their stockholders must see to it that their accounts are so kept as to show all accruing liabilities.

Then, just so far as is necessary to prevent wide fluctuations in our operating charges, we must provide in advance for future expenditures by setting aside regularly part of our annual income to meet these accruing liabilities.

"Depreciation" is one of the cost or expense items that must be treated as an accruing liability.

Generally the items of current repairs and renewals (Class 1) are paid for from current income, and frequently the deferred renewals (Class 2) are also cared for in the same way; but there still remain the final renewals or depreciation (Class 3), which cannot be so treated safely.

Some accountants claim that the annual expenses—and so the profits—are shown more accurately year by year by covering all the charges for up-keep of plant (Classes 1, 2 and 3) in a single inclusive charge, so making each year bear its share of this loss item, *no more and no less.* If this most desirable result could be thus attained, there could be little argument in favor of any other system. Those who favor this plan apparently lose sight of a fact that should be apparent at once to a practical plant manager; namely, that such an inclusive annual charge is determined neces-

sarily by an estimate based upon so many conditions, past, present, and future, that anything approaching absolute accuracy cannot be looked for reasonably. Therefore, in the interest of conservative management, it is best to pay currently for current repairs and renewals and make a liberal estimate for "depreciation," checking and correcting this estimate year by year as changes in conditions are developed. By thus paying currently for repairs and renewals as far as we can without varying too seriously the annual charge, we reduce the opportunity for error in our estimate on "depreciation," an advantage not to be regarded lightly.

Coming now to the items included in Class 2, the case is somewhat different. These renewals are much more serious in character. They are of more occasional occurrence and to charge them up to the expenses of the one year in which they occur would at times seriously impair the accuracy of the several yearly statements of loss and gain.

That is, the year in which the renewal of some large part of the plant was paid for would be called upon, in the statement of that year's loss and gain, to bear the total cost, while the other years which had had the benefit of the service of this part of the plant would have been relieved of all cost therefor. These items can be included in the estimate to cover "depreciation," or they can be cared for separately in a suspense account, which is designed to spread the cost over a number of succeeding years as later to be explained. The first method is the one more generally employed.

Coming to Class 3, "depreciation" or final renewal of plant, you are now prepared to appreciate the need for making some special provision from each year's income to meet this accruing loss.

The first step is to estimate as closely as we can the annual loss which may be occasioned by "depreciation." As the basis for this estimate we must assume (and it is only an assumption at the best) that each part of the plant may need to be renewed after a certain number of years.

In trying to estimate a length of life which we can be reasonably sure will be realized, we have to consider besides physical

decay the chances of the plant having to be discarded through becoming inadequate as to capacity, or obsolete as to efficiency or economy.

Then, to estimate the probable life of each part of the plant, it is necessary to take into consideration the class and character of plant; its design and construction; its capacity; the way in which it is operated; the present volume of business and prospects as to the future; whether it is overworked or not; whether it is kept in good repair; and whether the cost of the repairs is charged year by year against the profits. In estimating the expectation-of-life of plant we have therefore to take into consideration questions of accounting as well as questions of design, construction, operation, and maintenance of the plant itself.

Each part of the plant should be considered separately, and taking advantage of our own experience and that of others, and bearing in mind the special conditions already referred to, we should determine upon a safe expectation-of-life for each part of the plant. Even to secure a result which may be accepted as reasonably safe requires the best judgment of an engineer experienced in the construction and operation of the particular plant under examination.

Having thus assigned an expectation-of-life to each part of the plant, the several parts are to be grouped under the years so assigned. Thus all parts given a ten years' life will be grouped together, those of fifteen years will be grouped together, etc.

Bearing in mind that the purpose is to determine the annual cost of depreciation to be included as one of the loss items in the Loss and Gain Account, the expectation-of-life table should be made thoroughly conservative while having in mind the chances of the particular plant under examination becoming obsolete or inadequate in addition to the chances of physical decay.

In making this life-expectation estimate, as I have said, we may avail ourselves of the experience of others. But here we should be slow to accept the guidance of any of those whose qualifications have not been proved. Especially we should regard with suspicion the advice of those who are only theorists and who

attempt to estimate depreciation by rules and tables intended for general application. It may be excusable in an accountant without practical experience to assume that he can estimate the annual charge for depreciation by means of a life table which shows, for instance, that a steam power plant has a certain life, an electric light plant a certain other life, a gas plant still another life, etc. But this is inexcusable on the part of a man who has had practical experience and is endowed with even a moderate amount of common sense. To assume that certain kinds of apparatus and machines can each be given definite life-expectations, without regard to the special conditions involved, is quite indefensible. And yet you must expect to be asked, What is the life of a boiler? the kind of boiler not even specified. What is the life of an engine? What is the life of a gas holder? What is the life of a cast-iron main? If you endeavor to explain why such general questions cannot be answered, you will very likely be accused either of ignorance or evasion.

This inability on the part of those in positions of authority to understand that no such general rules and tables can be established for their guidance is bad enough in connection with the making of estimates to cover *future* depreciation, but, as I shall later show, it is much worse in the case of estimates of actual depreciation as an element to be considered in the appraisal of present value of plant.

Suppose an expectation-of-life table is to be made up for two plants of the same general character, one of which was well designed as to efficiency and capacity, well constructed of the best materials, operated within its capacity, carefully kept in repair, working parts renewed while having in mind correction of obsolescence and inadequacy as far as possible; and the other plant poorly designed, poorly constructed, worked beyond its capacity, and not even kept in repair. This comparison only needs to be stated to show that no general life table is applicable to both plants. And yet no two plants of the same general character, as for instance two gas works, can be found in which there will not be marked differences in one or more of the elements referred to.

Having examined each part of the plant and assigned a life-

expectation for each part, and having so developed a table of life-expectations, it should be assumed *for the purposes of this estimate* that at the end of each life period covered by the table the parts of plant included in each group will have to be renewed. Although in the interest of conservative management we must be governed by the assumption so made, it does not by any means follow that the several parts of plant will in fact have to be renewed at the end of the respective periods assumed, because many things may happen to change the estimate, especially in connection with obsolescence and inadequacy. As we should be careful to make the life estimates on the safe side, we may hope for longer lives than those assumed. If, as to any part, we have underestimated the element of inadequacy and we find the plant wholly or in part inadequate as to capacity before the expiration of the assumed life, we at least have the unexpected higher rate of increase in sales to compensate for the necessity of renewing plant in advance of our estimate. It may be in such a case that the investment of additional capital will be found to be fully warranted.

Before proceeding to construct an expectation-of-life table as the basis for an estimate of accruing depreciation, it must be determined what portion of the renewals shall be included with the repairs and so paid for out of current income. Certainly it will simplify our calculations to so provide for the minor repairs and renewals which I have assigned to Class 1. The more important renewals assigned to Class 2 can be taken care of from current income or can be included in the estimate to cover accruing depreciation, Class 3. If these more costly renewals are recurring year by year or nearly so at about the same cost, as might well be the case of the retorts and settings of a coal gas "bench," the distribution of this loss item takes care of itself with a fair degree of uniformity, and so we need not include such items in Class 3 in estimating accruing depreciation. Strange as it may seem at first thought, the parts of plant which have the shortest lives are the ones which occasion the least trouble in computing accruing depreciation, for the reason that the facts are soon known and provision can be made for them from current income, particularly

when plant of this class of about the same value has to be renewed each year. Take for instance the poles of a telephone company or the ties of a railroad company. Under known conditions as to the kind of wood, whether treated or untreated, the kind of soil, etc., a close estimate can be made of the life of these parts of the plant. If, for instance, it were found that the average life of a certain lot of poles was ten years, and if the construction had so extended over a certain number of years that one tenth of these poles could be renewed advantageously each year, there would be no need to include that plant group in the depreciation scheme, for the annual payments for renewals made from income and charged to loss and gain would keep that portion of the plant up to par. While there would always be some depreciation in the existing poles, the annual renewals would keep the poles constantly up to a uniform efficiency. At the end of a hundred years the pole line covered by such a system of renewals should be as sound and efficient as at the end of the first ten years.

Take another case, the consumers' meters of a gas company. Suppose that the repairs, renewals of working parts, and condemnations of wornout meters is a continuous process; and that by experience it has been determined that if all the meters are thus conscientiously and competently examined, tested, repaired, and renewed as required, once in every five years, the complete circuit of all the meters being thus made every five years, the meters as a whole will be maintained constantly at a practically uniform condition as to efficiency. Now if the annual cost of all of this work and also of the meters purchased to replace the condemned meters is charged up as one of the items of operating cost, then there is no accruing depreciation on this portion of plant and so consumers' meters can be disregarded in making up the expectation-of-life table. By the current expenditures under such a system the depreciation loss is spread over the years with practical uniformity, much more so probably than in the case of the parts of plant included in the expectation-of-life table. A little thought should convince (though it fails to do so apparently with some experts) that at any time the meters will be found of the same physical efficiency and worth *provided this scheme of*

repairs, renewals, and condemnation has been faithfully and competently maintained. Inadequacy is not likely to interfere with this scheme because a meter found to be too small for one customer can be used for another. As to obsolescence, a comparison of the design and construction of meters made fifty years ago with those made to-day, warrants the belief that there is not much to be feared from this cause.

I am giving these as examples of plant that can be maintained fully by current repairs and renewals.

While referring by way of example to gas plant, I will consider the item of cast-iron mains. In most soils cast-iron pipe, unless acted upon by electrolysis set up by stray currents from electric power plants, will last almost indefinitely. In exceptional soils the life is shortened. The outside of the pipe takes on a coat of rust, or rust and soil, which appears to protect the iron from further corrosion. On the inside the pipe is protected by the condensible hydrocarbon vapors of the gas.

I have myself examined carefully pipes which have been down fifty years and, as far as the quality of the iron was concerned, there seemed to be no impairment. Of course, it is quite possible that disturbances of the bed on which the pipes lie, due to the digging up of the streets for sewers and the like, might greatly impair the pipes; but this in the case of a well-conducted company might rather indicate that there was no necessity for including a yearly charge for depreciation because these troubles would have been cared for from time to time and the repairs would have been paid for out of the current income. In such a case it is quite possible that at the end of five, ten, fifteen, twenty or twenty-five years the main system in general might be in more effective condition for economical operation—that is, the delivery of gas without leakage—than when first laid. The weaknesses, as they made themselves evident, should have been corrected and the cost paid out of current income. This serves again to point out that in making up an expectation-of-life table it is necessary to examine, not only the conditions as to the plant itself, but the conditions as to the accounting methods followed.

In the case of cast-iron mains I do not mean to have it under-

stood that no provision should be made for accruing depreciation. A cast-iron main is not likely to become obsolete, although in the last twenty years other kinds of pipe have been suggested as designed to drive the bell and spigot cast-iron pipe out of use. There is far more chance of certain portions of the main system becoming inadequate. All of these chances have to be considered and so provision to cover possible accruing depreciation should be included in the expectation-of-life table and the estimate based thereon to cover "theoretical" depreciation.

I have referred to electrolysis as a disturbing element in our estimate. In many parts of the country gas mains and still more water mains, are being damaged by stray electric currents and this must be provided for in the depreciation estimate. Unfortunately, it is extremely difficult to estimate what may be the possible loss even though competent electrolysis surveys have been made. One thing we have as an offset—a claim against the company responsible for the damage.

It may be well to point out here that the case of cast-iron pipe as used for gas is very different from the case of the same pipe used for water. In the latter case it is the practice to coat the pipes inside and out with tar; some engineers are of the opinion that the coating is necessary or an advantage even on the outside of the pipe. The real advantage, however, is that it prevents oxidation on the inside of the pipe, for the water passing through carries with it more or less oxygen from the air; oxidation results; the pipe is reduced in thickness, because the scale as formed is carried forward by the push of the water, thus depreciating the pipe and developing a continuing trouble in connection with the operation of the plant, due to the scale being deposited in valve seats and the like.

So in the case of cast-iron water mains we are warranted in expecting less depreciation on the inside if they are coated before they are laid. But with gas mains the tar coating is a distinct disadvantage. Not only is it not needed for protection, as explained, but the tar deposited on the outside of the spigot ends and the inside of the bells is attacked and dissolved by the hydrocarbons of the gas, and so these two tar films which are included

in the caulked joint are cut away and leakage results. So definite is this fault that experienced gas engineers only accept tar-coated cast-iron pipe when they find it impossible to obtain the uncoated pipe to meet an immediate demand, and in these cases they are careful to burn off all the tar from the spigots and bells.

The conditions in regard to service pipes are quite different. These are generally made of wrought-iron or wrought-steel. In many kinds of soil, unless the pipe is thoroughly protected by an applied coating, the wrought-iron oxidizes more rapidly than the cast-iron, and the wrought-steel oxidizes more rapidly than the wrought-iron. Here again we have to take into account the degree of thoroughness with which the plant is maintained and the methods followed in the accounting department. If the services originally installed were of uncoated "black" pipe; and if year by year the services have been renewed when found defective; and if, learning from experience, the management has replaced the old uncoated pipes with pipes protected by a thoroughly effective coating; then this part of the plant may be in better condition for efficient and economical service than it was years before when uncoated pipe only was used. Furthermore, if the renewals have been charged to operating cost, as they should have been, the value under appraisal should at least support and perhaps exceed the book value.

Again, certain parts of the plant under investigation, other than those to which I have referred, might be found to need renewal on the average, say, every five years; and it might be that some of these parts would need renewal one year, and some the next, and so on. Then it might be that the cost of renewal of these parts of plant would be distributed not too unevenly over the five years' life period. If now these renewals are charged up to the operating cost of the year in which they are made, they should not be considered in the estimate upon which the expectation-of-life table is made up. Here, then, is an item which, because of its short life, might appear to be a most important element of accruing depreciation, but which, upon further consideration, we see is properly disregarded because it has already been cared for in repairs and current renewals.

I have given these few practical examples to show that it is the evidence of ignorance or inexperience for anyone to stand off at a distance, without examining the plant and the systems of maintenance and accounting, and attempt to apply expectation-of-life tables to determine the reduction in plant value due to depreciation.

Certainly I have said enough to show that the problem of estimating accruing depreciation is a most difficult one to solve even by the man who, by training and experience, is an expert. It follows that we should be prepared to amend our estimate from year to year as we have the opportunities to check up the correctness of the assumptions upon which we have based our estimate. Then again it follows that all the details of depreciation estimates should be recorded fully and exactly, so that as conditions change we *or those who follow us* may always be able to compare the results of the estimates with the facts as found.

Here, as with every record, especially in accounting, the statements should be completely self-explanatory. The failure to follow this simple rule is the cause of great waste and inefficiency, far more so than any one can appreciate who has not had bitter experiences of his own.

Now let us assume that a plant has been surveyed carefully in detail, and, having in mind all possibilities of accruing depreciation through obsolescence, inadequacy, and physical decay, each part of the plant has been assigned a certain expectation-of-life, eliminating from the estimate those parts which are completely maintained by current expenditures for repairs and renewals.

In considering the three elements named, it may be that the conditions found will indicate that one of the three threatens to so shorten the life of certain parts, that only this one element need be considered in the final judgment as to expectation-of-life. For instance, it may be that a certain part of the plant is found to be in excellent physical condition and of a capacity indicating adequacy for many years, but some recent change in the art threatens to make it obsolete in the near future. Or, the part may promise well as to physical condition and obsolescence, but be

of such inadequate capacity as to indicate the necessity for abandonment on this score in the near future.

Having so assigned an expectation-of-life to each part of plant which is not completely covered by current repairs and renewals, the several parts with their costs should be grouped in a table, each part according to its respective expectation-of-life. A further important condition should be introduced by estimating, as to each part of plant included, a salvage value to be deducted from original cost. A study of the plant and controlling conditions must determine whether the salvage assumed shall be based upon junk value, or upon service value as determined to meet less exacting conditions. Especially in the electric business the junk value of certain parts furnishes an important salvage value. It is fair to expect that with most parts of the plant there will be some residual value at the time of abandonment—in some few cases there may be none.

Let us now assume that, after deducting for estimated salvage, the net cost of those portions of the plant which are not completely covered by current repairs and renewals, and which therefore have to be included in the estimate of "theoretical" or accruing depreciation, is $500,000; and that the several parts can be grouped as shown by the following simple table.

EXPECTATION-OF-LIFE TABLE

Groups of Parts	Expectation-of-Life in Years	Net Cost in Dollars
A	10	$25,000
B	15	50,000
C	25	100,000
D	35	150,000
E	50	175,000
Total net cost,		$500,000

The first question is, What is the estimated annual depreciation which, according to this table, is to be included as an annual loss item?

If parts of plant costing as shown are, according to our conservative estimate, to be renewed respectively at the end of the years shown, the annual charge to loss and gain will be

For A	\$25,000÷10	=\$2,500
For B	50,000÷15	= 3,333⅓
For C	100,000÷25	= 4,000
For D	150,000÷35	= 4,285⅐
For E	175,000÷50	= 3,500
	\$500,000	Annual charge \$17,619

It may be convenient to have in mind what per cent of the total net cost of plant the estimate indicates should be withdrawn each year from income to cover accruing depreciation.

This is found to be \$17,619÷5,000=3.524%.

The question is often raised as to what is the "average life" of a plant. I am reluctant to include anything in these notes that can be taken as indicating that the average life of a plant can be determined in advance of the facts. Certainly no figures can be used for general application to determine the "average life" of any plant, for the reasons already given at length.

But under the conditions already named, if the expectation-of-life of the several parts is *estimated* to be as shown by the table, the *estimated* average expectation-of-life for the whole plant will be

\$500,000÷17,619=28.378 years

This division is carried out to three decimal places because I wish later to make certain comparisons in connection with the sinking-fund treatment of depreciation. As far as the estimated "average life" is concerned, the fractions of a year are not of moment in view of the many assumptions which enter into the estimate.

As long as the "average life" enters so largely into the computations of accountants and others in estimating depreciation, it

may be well to point out here an error which is sometimes made in calculating the "average life" from such a life table as I have shown, as follows:

Years		Cost of parts in dollars	
10	multiplied by	$ 25,000	= $ 250,000
15	multiplied by	50,000	= 750,000
25	multiplied by	100,000	= 2,500,000
35	multiplied by	150,000	= 5,250,000
50	multiplied by	175,000	= 8,750,000
		$500,000	$17,500,000

$$\$17,500,000 \div 500,000 = 35$$

and thus the "average life" is calculated erroneously to be 35 years.

It is only because this error has occasioned trouble that I take the time to refer to it. Presumably those making the mistake do so because they fail to see the difference between this depreciation problem and, by way of example, the average of the weights of certain castings. For instance, if we had 25,000 castings weighing 10 pounds each; 50,000, weighing 15 pounds each; 100,000, weighing 25 pounds each; 150,000, weighing 35 pounds each; and 175,000, weighing 50 pounds each; the average weight of these castings would be 35 pounds.

But if in this way we desire to calculate the average life from our estimated expectation-of-life table, we must state our proposition so as to include all the dollars involved in the full fifty years period. For example, during the fifty years period, according to our estimate, we have to renew Parts A, $25,000, five times, for they have to be renewed every ten years; Parts B, $50,000, we have to renew three and one third times; and so on.

The following table shows the full computation:

Years (a)	Cost of parts in dollars (b)	Times renewed in 50 years (c)	Total requirement in 50 years (d) Col. (b) × Col. (c)	Dollar Years Col. (d) × Col. (a)
10	$ 25,000	5	$125,000	$1,250,000
15	50,000	3⅓	166,666⅔	2,500,000
25	100,000	2	200,000	5,000,000
35	150,000	1⅗	214,285⅝	7,500,000
50	175,000	1	175,000	8,750,000
	$500,000		$880,952	$25,000,000

Dividing the total dollars years by the total dollars to be provided in the fifty years period we have for the "average life," $25,000,000÷880,952=28.378, as before found.

Having satisfied ourselves that in view of all conditions found, we have estimated the accruing depreciation to the best of our ability and especially being satisfied that the estimated annual charge is reasonably large enough to cover all contingencies, the next question is, How shall the amount so retained each year from income be financed to compensate for this impairment of capital, definite as to the fact but indefinite as to extent? This is a question quite apart from the problem of estimating the amount to be annually charged.

In the United States the amounts so withdrawn from income to cover accruing depreciation, over and above the amounts required year by year to cover current repairs and renewals, generally have been invested in extensions and betterments to meet the developing requirements of the undertaking. Provided this method is followed advisedly, there can be no objection to it in the case of a company constantly requiring additional capital to meet demands for increase in plant.

If in a sinking fund scheme, as later to be explained, we can only calculate upon an average compound interest rate of 4 per cent, and we can earn on the depreciation fund an average of 5 to 10 per cent in our own business, it seems to be in the interest of true economy to invest the depreciation fund in plant provided

there is a legitimate demand for such extensions. In practically every industrial concern in which I have been interested, this demand constantly exceeded in amount the depreciation fund. I shall discuss this portion of our subject more at length after the sinking fund method has been considered.

Of late years, and especially in connection with commission control of public utilities, the question of "depreciation" has received much attention in this country. In the minds of our amateur and professional reformers there seems to be a conviction that before they entered upon the scene, this important matter had been lost sight of or deliberately disregarded by managers of industrial properties. Nothing could be much farther from the facts *as to general practice*. It is too true that in a number of cases which came prominently before the public on account of the disastrous results of bad and dishonest management in this and other connections, accruing depreciation was neglected and renewals of plant, which should have been covered from income at least in part, were paid for by the issue of additional capital securities.

It is also true that in many cases no specific effort was made to estimate the accruing depreciation, but the managers of industrial properties at the end of prosperous years after paying the regular dividend, charged up the part or whole of the surplus earnings to Loss and Gain Account, crediting the same to Plant Account.

In considering accountancy as applied to depreciation, we shall see that this process, while more or less haphazard, was a complete protection against impairment of capital provided the amounts so charged against income were sufficient in amount and provided no additional capital securities were later issued against these depreciation charges. Let it here be noted particularly I am now referring to the cases where the income was sufficient to pay all expenses, including depreciation, and also a fair return on the investment.

That there may be no misunderstanding on a question of vital importance, let me here point out a distinction.

If the amounts withdrawn from income and charged against depreciation are found or believed to be no more than sufficient

to cover accrued and accruing depreciation, no surplus has been accumulated and so no warrant for the issuance of additional capital obligation has been established.

On the other hand, it is entirely legitimate to represent increase in actual value by addition to capital obligations provided it can be demonstrated that the amounts charged for depreciation have been more than sufficient to keep plant value up to par. In other words, if the actual value of property is found to exceed the "book (ledger) value," the stockholders have a clear title to this additional property quite as much as they had to the original property, and so theirs is the right to have this additional value represented by the proper evidences of ownership if they wish to have these evidences in more expanded form. Such a state of affairs indicates that the company's net earnings have not been all paid out in dividends, but part have been reinvested in the business for the benefit of the proprietors. This last is practically what has been taking place in all well-managed, prosperous concerns, whether the surplus so earned has been represented later by additional capital obligations or not. The question as to what extent such surplus earnings shall be represented by additional capital obligations is a matter of business judgment.

I have found that certain students of economics, who pose as reformers, find it difficult to understand or believe that in many of our industries depreciation has been generally covered sufficiently by the methods I have just briefly described, and that as a result many of our great industrial properties and railroads have little or nothing to fear from a physical appraisal except the expense involved, the tremendous difficulties to be overcome in many cases, and the well-grounded fear of incompetency or prejudice on the part of those in charge of the work. My own experiences in connection with the examination and appraisal of industrial properties convince me that generally the conditions in this respect are much better in the United States than is popularly understood or is even understood in many cases by those most directly concerned. I take this opportunity to record the opinion that certain of our professors of economics, engaged in directing the studies of the youth of the nation gathered together in colleges and universities, will

before many years find it necessary to revise their lecture notes on this question.

This is a good place to point out that we have no right to expect that all depreciation, especially that due to obsolescence, shall necessarily be a charge against income. If, from the first, a strict scheme for charging all depreciation against income had been enforced against electric light and electric railway undertakings, the extraordinary advances in the art which have enabled these industries to minister in such marked degree to the convenience and comfort of mankind, could never have been made. Additional capital had to be supplied constantly to replace obsolete apparatus. Replacements of this kind followed each other in rapid succession. To ignore these facts and now to allow these undertakings only the reproduction cost less depreciation of the existing plant, would in effect work confiscation. In other words, there are certain losses involved in the development of a new industry, and even of a new business, which are legitimate charges against capital. As we come to consider "overhead charges" in connection with the study of specifications and estimates, this point will be developed further. This is a matter which must be considered even in the appraisal of physical properties. As the construction of all physical properties has been subject to the losses necessarily involved in the imperfections of the human agents who have designed and constructed these properties, in appraising a property spread out before us, we have no right to ignore the omissions, contingencies, and mishaps which necessarily have been included in the construction of every plant which has been put into operation. We have a right to demand that good average ability and care shall have been exercised in their design and construction—certainly we have no right to demand perfection in human agencies. When we find in construction or operation a result above the average, due to efficiency above the average in the human agencies, the credit and the profit for this higher degree of efficiency and economy should be credited, at least in part, to those who, as courageous investors and competent engineers and managers, have secured this result. While a wise scheme of management will accord to the buyer a participation

in the increased earnings so obtained, fairness to the management and the proprietors demands that some of the advantages should be retained for the benefit of those who have made possible this decreased cost to the buyer.

We now come to the consideration of the sinking-fund method of financing "depreciation." For illustration I shall use the same expectation-of-life table as before.

Under this plan the cash has to be withdrawn each year from income and set aside to accumulate at compound interest, so that principal plus interest accumulations will, at the end of the several life periods, equal the original cost of the respective plant groups. And here, for simplicity, we should consider each group, A, B, C, D, and E, as covered by a separate and distinct sinking fund, as will appear later.

To determine what rate of compound interest it is safe to assume as being obtainable through a long series of years, requires the trained judgment of the banker; and here again, the result is only an estimate founded upon an educated judgment. Having so assumed a rate of interest, we come to the sinking fund calculations. This is rather the specialty of the actuary. Finally we have to place the results upon the books of account, and here we are in the realm of the accountant. This last part of the subject will be treated separately so as to cover several methods of financing.

We will assume that the interest is to be received and compounded yearly. It is probable that the interest might be compounded half yearly, but the principle is the same and the treatment is somewhat simpler if we assume compounding at the end of each year only.

If we set aside each year for n years a constant number of dollars to accumulate at compound interest, we have a geometrical progression. It may be convenient if we are reminded that a geometrical progression is a series of numbers each derived from the preceding by multiplication by a constant factor. As annuity tables are not always at hand it may also be convenient if we are reminded of the equation and its derivation. This elementary discussion will be of value also in connection with some of the points to be considered.

Let A be the annual payment into the fund;

r, the constant factor, namely 1, plus the rate of interest expressed as a decimal fraction;

n, the number of terms or years during which the payment is made into the fund;

S, the sum of n terms or payments.

The first payment, A, will be made at the *end* of the first year. At the end of the second year this first payment will have been increased by interest accumulation to Ar; at the end of the third year this will have been so increased to Ar^2; at the end of the fourth year to Ar^3; and at the end of the nth year to Ar^{n-1}. The second payment, A, with one year less of interest accumulation, will in the same way have been increased in n years to Ar^{n-2}; the third payment to Ar^{n-3}. The last payment, made at the end of n years, will have had no time to accumulate interest so it will be A, the next to the last with one year's interest will be Ar, the second from the last, Ar^2, and so on.

So we have as the sum of these payments:

1. $S=A+Ar+Ar^2+Ar^3+ \ldots . \quad +Ar^{n-3}+Ar^{n-2}+Ar^{n-1}.$

Ar^{n-1} being the first payment into the fund, and A the last payment.

Multiplying by r we have

2. $Sr=Ar+Ar^2+Ar^3+Ar^4+ \ldots . \quad +Ar^{n-2}+Ar^{n-1}+Ar^n.$

Subtracting No. 1 from No. 2 we have

$$S(r-1)=A(r^n-1).$$

$$S=A\,\frac{r^n-1}{r-1},\quad A=S\,\frac{r-1}{r^n-1}$$

In solving for A, the annual payment, we can let S be the total amount, and so find the total amount of plant cost, or we can let S equal 100 or 1, and so find A in terms of per cent of plant cost.

With this equation let us determine the amount to be set aside

each year to compound annually at 4 per cent interest to redeem the cost of parts in group A, $25,000, in 10 years.

$$A=25000\ \frac{1.04-1}{1.04^{10}-1}$$

The 10th power of 1.04 can be found by logarithms or compound interest tables, as given in Kent's and other pocket books, or in arithmetic text-books, these tables also serving as tables of powers. For instance, referring to the 4 per cent column, the first year shows 1.04; the second year $1.04\times1.04=1.0816$; the third year $1.0816\times1.04=1.124864$; and the tenth year 1.480244. A table conveniently arranged for this purpose is appended to these notes.

$$\text{Then } A=25000\ \frac{1.04-1}{1.4802-1}=\frac{1000}{.4802}=2082$$

Then an annual payment of $2,082, compounding annually at 4 per cent, will produce in ten years $25,000.

Our determination will be adapted better to general application if S is taken to equal 1 or 100.

Letting S=1, we have $A=1\ \frac{1.04-1}{1.04^{10}-1}=.0833.$

$$S=100, \text{ we have } A=100\ \frac{1.04-1}{1.04^{10}-1}=8.329.$$

$$25000\times.0833, \text{ or } 250\times8.329=2082$$

Applying this last method to the entire expectation-of-life table we have:

$$\text{Part A, 10 years, } A=100\ \frac{1.04-1}{1.04^{10}-1}=8.33 \text{ per cent.}$$

$$\text{Part B, 15 years, } A=100\ \frac{1.04-1}{1.04^{15}-1}=4.99 \text{ per cent.}$$

$$\text{Part C, 25 years, } A=100\ \frac{1.04-1}{1.04^{25}-1}=2.40 \text{ per cent.}$$

Part D, 35 years, $A=100\frac{1.04-1}{1.04^{35}-1}=1.36$ per cent.

Part E, 50 years, $A=100\frac{1.04-1}{1.04^{50}-1}=0.66$ per cent.

For a better understanding of the principles involved, having thus obtained from the formula the per cent of cost of each part of plant to be set aside in a 4 per cent sinking fund, we may now refer to tables which will give these values directly.

These tables for quite a wide range of interest rates and years are to be found in life insurance annuity tables, in engineers' pocket books such as Kent's, in Matheson's "Depreciation of Factories," etc.

A table conveniently arranged and carefully checked, giving per cent values of A in the equation $A=S\frac{r-1}{r^n-1}$, r being given for 1.025, 1.03, 1.035, 1.04, 1.045, 1.05 and 1.06, and n being given for every year from 1 to 100 inclusive, is appended to these notes. The results are only carried to the second decimal place, which is quite sufficient for the work in hand. If for any special purpose a more accurate determination is required, the equation can be solved by logarithms.

It is to be noted that these annuity tables are based upon different values for S. Life insurance and Kent's annuity tables give the amounts required to redeem \$1,000; Matheson's gives S=£1; my table gives S=\$100. It seems worth while in the interest of accuracy and efficiency to point out these differences when we find bookkeepers and others who are constantly dealing in figures placing in a column with the heading "per cent" the figure .02, intending it to mean 2 per cent. Even with engineer-students it may not be amiss to remind them that the placing of a decimal point is a matter of importance in all computations, and may be a matter of the gravest moment.

We are now prepared to develop our expectation-of-life table by the assistance of the table page 570, and so determine the total annual payment to be made to the 4 per cent sinking fund.

Groups of parts of plant	Expectation-of-life in years	Cost of plant groups. Dollars	Per cent required to redeem	Amount to be set aside each year for each group and total dollars
A	10	25,000	8.33	2,082.
B	15	50,000	4.99	2,495.
C	25	100,000	2.40	2,400.
D	35	150,000	1.36	2,040.
E	50	175,000	0.66	1,155.
Totals and average		500,000.	2.03	10,172.

As it may be convenient, for ready reference and comparison, to know what is the average per cent required by the sinking fund method to cover accruing depreciation on the whole plant, we divide 10,172 by 5,000 and find it to be 2.03 per cent.

Referring to the annuity table we find in the 4 per cent column for 27 years, 2.12 per cent, and for 28 years, 2 per cent. Then the so-called average life, as employed in these sinking fund calculations, would be something less than 28 years.

But here again it must be understood fully that no average per cent and no "average life" can be derived direct from tables prepared for general application. Each group of parts of plant must be considered by itself and the amount required in each case for redemption must be considered as a sinking fund by itself. That is, unless the sinking fund is so built up that, at the end of each period included in the expectation-of-life table, there will be sufficient in the fund to meet the cost of those portions of the plant included in each group, without encroaching in the slightest degree upon the amounts accumulating to redeem the parts included in the other groups, the sinking-fund scheme is mathematically defective. In still other words, the several amounts to cover the several groups, which together make up the total annual requirement for the sinking fund as a whole, are each entirely separate and distinct sinking funds, though they are combined for convenience as to investment.

Furthermore, we must here again have it in mind that even when the sinking fund scheme as developed from the conditions

assumed is mathematically correct, that in no measure serves to prove the accuracy of our assumptions. All this as thus stated sounds very elementary, but almost daily experience demonstrates that these elementary truths are lost sight of constantly by some of those who attempt to give expert advice on depreciation.

To further illustrate the error in the "average life" of 35 years by applying this life to a sinking-fund scheme; to illustrate that the amounts set aside to cover each plant group should be considered as making up a separate sinking fund; to illustrate that the amount in each of these sinking funds will equal the amount to be redeemed only at the expiration of the expectation-of-life period assumed, and that the amount in the combined fund can never equal exactly the total plant value unless the life periods for all groups of plant terminate at some one time, and then only at that particular time; to show that the so-called average life as determined by the sinking-fund method and the actual average life as determined directly are not the same, and that the sinking-fund "average life" varies with the sinking-fund rate of interest, and to open up the subject generally, I shall now make some computations in detail based upon what has gone before.

I have already shown that the expectation-of-life table we have been considering, giving an average life of 28.38 years, would, by some, be erroneously averaged to 35 years; and this by ignoring the repeated renewals of parts of plant within the 50 years as called for by the table.

Let us apply this 35 years to a 4 per cent sinking-fund scheme and compare with the correct results already given.

Referring to our annuity table we find in the 4 per cent column for 35 years, the rate to be 1.36. We will use the little more exact figure of 1.358 as the effort is to be made to balance some of our results. Then the total annual payment to be made to the combined sinking fund is only $1.358 \times \$5{,}000 = \$6{,}790$, instead of \$10,172 as before found to be correct.

At the end of the first 10 years there will have accumulated

$$S = A\,\frac{r^n - 1}{r - 1} = 6790\,\frac{1.04^{10} - 1}{1.04 - 1} = 6790\,\frac{.4802}{.04} = 81{,}514.$$

Withdrawing \$25,000 required to renew Parts A, we have left \$81,514—\$25,000=\$56,514. This will accumulate by the end of the next 5 years (15 years in all), when Parts B have to be provided for, \$56,514×1.2167 (\$1.00 compounded 5 years at 4 per cent)=\$68,760; and the additional yearly payments to sinking fund will accumulate to

$$S=6790\,\frac{1.04^5-1}{1.04-1}=6790\,\frac{1.2167-1}{1.04-1}=36{,}785.$$

The total accumulations will be \$68,760+\$36,785=\$105,545. Withdrawing the \$50,000 required to renew Parts B, we have a balance left, \$105,545—\$50,000=\$55,545.

At the end of the next 5 years (20 years in all) we have to provide for a second renewal of Parts A.

During this time the balance of \$55,545 will accumulate to \$55,545×1.2167=\$67,582; and during this time the additional annual payments will accumulate to \$36,785, as before calculated. The total accumulations will be \$67,582+\$36,785=\$104,367.

Withdrawing the \$25,000, to again renew Parts A, we have a balance left, \$104,367−\$25,000=\$79,367.

At the end of the next 5 years (25 years in all) we have to provide for the renewal of Parts C, \$100,000.

During this time the \$79,367 will accumulate to \$79,367× 1.2167=\$96,566; and during this time the additional annual payments will accumulate to \$36,785, as before calculated. The total accumulations will be \$96,566+\$36,785=\$133,351.

Withdrawing the \$100,000 to renew Parts C, we have a balance left of \$33,351.

At the end of the next 5 years (30 years in all) we have to renew Parts A for the third time, \$25,000, and Parts B for the second time, \$50,000, making \$75,000 in all.

During this time the balance of \$33,351 will accumulate to \$33,351×1.2167=\$40,578; and the additional annual payments will amount to \$36,785, making the total accumulations \$77,363.

Withdrawing \$75,000 for renewing Parts A for the third time and Parts B for the second time, we have a balance left of only \$77,363—\$75,000=\$2,363.

At the end of the next 5 years (35 years in all) we have to renew Parts D for the first time, requiring $150,000; and during this time the balance of $2,363 will accumulate to $2,363×1.2167 =$2,875.

Adding the accumulations of the annual payments for 5 years, $36,785, we have a total accumulation of $2,875+$36,785= $39,660.

So after renewing Parts D, $150,000, we are in debt $150,000 —$39,660=$110,340.

Thus at the end of 35 years, which was assumed as the average life of plant, we are in debt for depreciation renewals $110,340, and falling behind all the time, as will be seen.

At the end of the next 5 years (40 years in all) we have to renew Parts A for the fourth time, requiring $25,000.

The deficit of $110,340 will during this time increase to $110,340×1.2167=$134,251. The total to be provided for is therefore $134,251+$25,000=$159,251. Against this we have only the yearly accumulations amounting to $36,785. So now our deficit is increased to $159,251—$36,785=$122,466.

At the end of the next 5 years (45 years in all) Parts B have to be renewed for the third time, requiring $50,000.

By this time our deficit will be increased to $122,466× 1.2167=$149,004. The total to be provided for is, therefore, $149,004+$50,000=$199,004. Against this we have only the yearly accumulations, amounting to $36,785. So now our deficit is increased to $199,004—$36,785=$162,219.

At the end of the next 5 years (50 years in all) we have to provide for the fifth renewal of Parts A, $25,000, the second renewals of Parts C, $100,000, and the first renewal of Parts E, $175,000; $300,000 in all.

The deficit of $162,219 during this time increases to $162,219 ×1.2167=$197,372. The total to be provided is, therefore, $300,000+$197,372=$497,372. Against this we have only $36,785, the yearly accumulations for the 5 years; which, deducted, leaves a deficit of $460,587.

Thus it is seen that by the incorrect "average life" scheme thus tested, at the end of 50 years, notwithstanding having laid aside

$6,790 each year at 4 per cent compound interest, we are actually in debt for renewals we have been obliged to make to the extent of $460,587, the original value of the plant being only $500,000; and in addition there is no provision for accrued depreciation, as later to be shown.

In the correct sinking-fund scheme which I have shown, requiring an annual payment to depreciation sinking fund of $10,172, each group of parts is treated separately and, at the end of the life of each group, an amount equal to the cost of this group has accumulated for renewal, and so this part of annual payment to sinking fund is free to go on accumulating to pay for the next renewal of the group of parts concerned.

As before pointed out, while, for convenience of statement and to facilitate convenient comparisons with other cases of depreciation cost, we may calculate the average per cent of total value of plant to be laid aside each year—finding it in this case 2.03 per cent—still we must not forget that this total is made up of distinct annual redemption payments, each to take care of its own group of parts of the plant and to renew those parts as *often* as the table calls for. For the purposes of this discussion we will call this the separate life scheme.

As the subject of depreciation is of commanding importance, and as the results obtained from the two estimates which I have shown differ so widely, and as it is difficult to understand why the difference at the end of 50 years should amount to almost the original total value of the plant, I shall make a further analysis of the results obtained by these two computations.

If $6,790 (the amount called for by the incorrect "average life" scheme) were paid into sinking fund each year and accumulated *undisturbed* for 50 years at 4 per cent compound interest, the total accumulations of the sinking fund would then be:

$$S=A\,\frac{r^n-1}{r-1}=6790\frac{1.04^{50}-1}{1.04-1}=6790\,\frac{7.1067-1}{1.04-1}=1{,}036{,}612.$$

If $10,172, the amount called for by the separate life scheme, were treated in the same way, at the end of 50 years the total would be:

$$S=10{,}172\ \frac{7.1067-1}{1.04-1}=1{,}552{,}934.$$

As the same expectation-of-life table is used in both of these cases, the withdrawals would be the same. In the following table I show these withdrawals, and I also show the number of years in each case remaining up to the end of the 50 years, during which the amounts so withdrawn would have gone on accumulating at 4 per cent compound interest if they had been left undisturbed, and the total accumulation thereby in each case.

1	2	3	4	5	6
At End of Years.	Parts to be Renewed. Group.	Amount Required for Renewals. -$-	Unexpired Part of 50 Year Term. Years.	Value of $1. Compounded at 4% for Years Given	Amounts Accumulated at End of 50 Years. Principal and Interest. Col. 3 x Col. 5 -$-
10	A	25,000	40	$1.04^{40}=4.8010$	120,025.
15	B	50,000	35	$1.04^{35}=3.9461$	197,305.
20	A	25,000	30	$1.04^{30}=3.2434$	81,085.
25	C	100,000	25	$1.04^{25}=2.6658$	266,580.
30	A and B	75,000	20	$1.04^{20}=2.1911$	164,332.
35	D	150,000	15	$1.04^{15}=1.8009$	270,135.
40	A	25,000	10	$1.04^{10}=1.4802$	37,005.
45	B	50,000	5	$1.04^{5}=1.2167$	60,835.
50	A, C and E	300,000	0	$1.04^{0}=1.$	300,000.
		$800,000			$1,497,302.

Referring to the "separate life" scheme we have seen that if $10,172 were paid into the sinking fund yearly and not disturbed, the total accumulations would amount to $1,552,934

If now we deduct the amounts withdrawn, with accumulated interest, as shown in last table . . . $1,497,302

we find we should have in the sinking fund at the end of the 50 years . . . . . $ 55,632

If our calculations are correct, this should equal the accrued liability for depreciation at the end of the 50 years after paying for all the renewals up to and including that date. Groups A, C and E were renewed at the end of 50 years, so we have to consider only groups B and D.

B was renewed for the third time at 45 years, and so there has accrued a 5-years' liability on those parts of plant.

D was renewed for the first time at 35 years, and so there has accrued a 15-years' liability on those parts of plant.

By the original life table it was shown that Parts B required an annual payment to sinking fund of $2,495, and Parts D, $2,040.

Then there should remain in the sinking fund at the end of 50 years, after paying for all renewals up to and including that year:

B. $$S=2495\,\frac{1.04^5-1}{1.04-1}=2495\frac{1.2167-1}{1.04-1}=13{,}517$$

D. $$S=2040\,\frac{1.04^{15}-1}{1.04-1}=2040\frac{1.8009-1}{1.04-1}=40{,}846$$

54,363

which practically agrees with the amount remaining in the sinking fund after all the withdrawals for renewals just shown, amounting to $55,632. The difference would disappear if all computations were carried out to a sufficient number of decimals.

By the incorrect "average life" scheme, we have seen that the total in sinking fund at the end of 50 years, if the fund had been undisturbed, would have been $1,036,612.

By the table of withdrawals we found that these amounts with interest were $1,497,302

This shows a *deficit* of 460,690

which is in practical agreement with the deficit first shown by detailed analysis, which was . . . . $ 460,587

If to this deficit we add the accrued liability as shown in the case of the "separate life" scheme, we have a total deficit of $460,587+$54,363=$514,950.

If our computations are correct, this should be equal to the

difference between the totals of the accumulations under the two systems, if undisturbed to the end of the 50 years:

Separate life system	$1,552,934
Incorrect average life system	1,036,612
Difference	$ 516,322

which is in practical agreement with the total deficit already shown.

To guard against possible misconception as to the so-called average life of plant in connection with the sinking fund method of financing accruing depreciation, we may well consider more in detail the difference, in this and some other respects, between the sinking-fund method and the direct method.

We have seen that independently of the method employed to finance the accruing depreciation liability, the expectation-of-life table requires that at the expiration of life of each group of parts, *and at each recurrence thereof,* the depreciation fund or account shall have accumulated an amount equal to the cost of that group, and this without depleting the fund with respect to the remaining groups of parts. This result is secured, as already shown, by considering and providing for each group of parts separately. And as we have seen, the total annual charge for depreciation will be the sum of these amounts as found to be required for the several groups.

Now, if for purposes of comparison or for any other purpose, we wish to average the results so obtained, either as to per cent of total cost or average expectation-of-life, by the very terms of the proposition we are to consider *the plant as a whole, all parts expiring at the one time, and the depreciation account or the sinking fund to be left undisturbed, to accumulate until the end of the average time so found.*

By the direct ("straight line"—no interest) method, charging to operating cost each year the total estimated accrued depreciation for the year, the accumulation of annual payments to the credit of the account must necessarily be equal at the end of each and every year to the total estimated accrued depreciation.

By the compound interest sinking-fund scheme this necessarily

would never be the case unless a time were reached when all parts of the plant expired at the same time, and then only at the end of that time; for here it must not be forgotten that only at the end of each group life will the annual payments plus interest accumulation equal the group cost. In the expectation-of-life table which we have been using for illustration there will be for many cycles an overlapping of the life periods of the several groups of parts of plant, and there would be in the sinking fund an amount equal to the accrued depreciation only at the end of each period of 1,050 years, though there will always be enough to meet the requirements of each group of parts at each expiration of its assumed life. To illustrate:

We have seen that at the end of 50 years we should have in the correctly computed 4 per cent sinking fund, after making all payments required for the renewal of groups of parts A, B, C, D and E, $55,632. The computations were then made to show what should be the accrued *sinking-fund liability* on account of the depreciation of groups B and D, the lives of which overlap the 50 years included in the table. It was then shown that the 5 years' sinking-fund liability on group B, and the 15 years' on group D, would amount to $54,363, being practically in agreement with the balance found in the sinking fund. But this is not equal to the accrued estimated *depreciation* under the assumption that the depreciation is uniform year by year, which would amount to

Group B.	15 years life, $50,000. Depreciation accrued on 5 years elapsed after third renewal, $50,000 × 1/3 =	$16,666.67
Group D.	35 years life, $150,000. Depreciation accrued on 15 years elapsed after first renewal, $150,000 × 3/7 =	64,285.71
	Total accrued depreciation,	$80,952.38

We have also seen that by the direct method, the total annual charge for depreciation according to the expectation-of-life table

we have been using, is $17,619, which is 3.524 per cent of $500,000, the assumed net cost of plant; and dividing the $500,000 by the annual charge of $17,619, we have found the average life of plant to be 28.378 years.

By the 4 per cent sinking-fund scheme we found the total annual payment to be $10,172, which is 2.03 per cent of $500,000, and by reference to the 4 per cent annuity table we found the average 4 per cent sinking fund life to be something less than 28 years. The average life and the sinking-fund average life so found are so nearly alike that one might be led to suppose that they should be in complete agreement, and that the failure to so agree is due to lack of exactness in the compound interest computations. But if the average sinking-fund life is computed directly from the equation it is found to be 27.73 years.

A little study shows that an agreement should not be expected.

The 28.378 is a true average life as based upon the assumed table,—that is, *the number of years which will elapse when the plant will have depreciated to an amount equal to its net first cost of $500,000,* and hence the number of years in which the sum of the annual payments, each equal to the annual depreciation, $17,619, will, if not withdrawn, equal the total net cost of plant.

As opposed to this, the 27.73 years is the number of years in which an annual payment of $10,172 into a 4 per cent sinking fund will accumulate to $500,000, if nothing is withdrawn from the fund in the meantime.

To illustrate further that the average life as found from the direct method is not the same as the time during which a compound interest sinking-fund scheme, if undisturbed, will accumulate the total net cost of plant, I show for comparison, in the following table, the direct method ("straight line") and a 2 per cent, 4 per cent, and 6 per cent sinking fund applied to the expectation-of-life table which we have been using:

Groups of Parts of Plant.	Expectation-of-Life in Years.	Cost of Plant Groups. Dollars.	Annual Payments to Cover Depreciation.			
			Sinking Funds			Direct "Straight Line."
			6%	4%	2%	No Interest.
A	10	25,000.	1,897.	2,082.	2,283.	2,500.
B	15	50,000.	2,150.	2,495.	2,892.	3,333.33
C	25	100,000.	1,820.	2,400.	3,122.	4,000.
D	35	150,000.	1,350.	2,040.	3,000.	4,285.71
E	50	175,000.	595.	1,155.	2,068.	3.500.
Totals		500,000.	7,812.	10,172.	13,365.	17,619.
Annual payment in per cent of plant cost			1.562	2.03	2.673	3.524
If undisturbed, years required to accumulate total cost of plant			27.05	27.73	28.2	28.378

It is thus seen that the compound interest sinking-fund scheme is essentially different from the direct scheme which does not involve interest accumulations. And by the above table it is shown that the average life, as determined correctly by the direct scheme, is longer than the time found by averaging the sinking-fund payments; also that the higher the sinking-fund rate of interest the shorter will be the time so found.

Thus it is seen that it is misleading to speak of the average life as found from a compound interest sinking fund.

We have now considered at some length the two methods of financing theoretical depreciation:

The direct, or "straight line," method by which the total annual cost of accruing depreciation is invested in plant betterments or extensions; and the

Sinking-fund method, by which such an amount only shall be set aside each year as will meet the demands of the expectation-of-life table, if allowed to accumulate at compound interest.

In the example we have followed through, it is found that the first method requires an annual charge against income of $17,619, whereas the 4 per cent sinking-fund method requires an annual charge of only $10,172.

This large difference is an argument frequently used in favor of the sinking-fund method. But I have already pointed out

that if there is required annually for extensions and betterments an amount equal to or in excess of the annual cost of depreciation, and these extensions and betterments promise to increase our net earnings to an amount in excess of 4 per cent (or other rate obtainable in a sinking fund) it is economy to so employ the depreciation fund.

The question is then asked frequently, If the depreciation fund is expended for betterments and extensions, how shall the renewals be paid for when the times for such renewals arrive? The answer to this is, that unless the depreciation fund had been so drawn upon, the financing of the betterments and extensions must have been met by some other means and these means can now be better employed to pay for the renewals. The probabilities are that if the depreciation fund had been put out at interest, money for improvements would have been borrowed at a higher rate of interest. The day of borrowing has been postponed and money so saved.

Here it is to be borne in mind again that the financing of the depreciation fund is quite apart from the estimating of the cost of depreciation and the charging of this loss annually against income. If the assets as a whole are so maintained at cost, it is a secondary consideration as to the exact form of the assets, provided they are as fully productive as conditions permit.

Some "experts" contend that the depreciation fund should be held inviolate to renew each individual part of the plant as it is abandoned. Perhaps certain parts of the plant never will be renewed, but some equivalent may be substituted or even some part may be installed to produce income from a different and more productive line of manufacture. This is one of the considerations in mind when we include obsolescence in the estimate of accruing depreciation. Should we then renew the part to be abandoned irrespective of the question of efficient and economical management? The question answers itself; and yet this question logically follows from the arguments sometimes made against employing the depreciation fund in the ways I have advised.

Especially in the earlier years of a new undertaking, in the effort to make as good a showing of profits as possible, the

smaller sinking fund charge for depreciation is resorted to. Sometimes the same reason governs in the case of concerns long established.

In the case of the depreciation fund being invested in our own business, the separate and additional profits earned by each betterment or extension paid for from the fund could be segregated so as to determine in each case the exact rate of return; but this would require a most complicated scheme of accounting without returning adequate benefit.

It is assumed, of course, that the methods of accounting followed would furnish sufficient information to determine in a general way whether these extensions and betterments were giving, either directly or indirectly, such a return as to warrant the expenditure.

If, however, we should decide to set aside for depreciation the amount called for by a sinking fund, the company to sustain its own sinking fund from the undivided income of the business, the annual payment would, of course, increase year by year.

The following table is introduced to show how the annual payments would increase and to emphasize the fact that the actual loss by depreciation is not limited to the amount taken from profits and placed in a sinking fund, but also includes the interest accumulations.

For this table an average sinking-fund life of 40 years is applied to a 4 per cent and a 5 per cent sinking fund:

RESULT OF COMPANY OPERATING ITS OWN SINKING FUND AND THUS HAVING TO SUPPLY PRINCIPAL AND INTEREST.

40 Years Sinking Fund Life. Yearly Payments per $100 to Include Compound Interest Accumulations as Obtained from Earnings.

YEARS	4% Compounded Annually. Amount annually required to accumulate $100 in a 4% Sinking Fund at end of 40 years is $1.05.		5% Compounded Annually. Amount annually required to accumulate $100 in a 5% Sinking Fund at end of 40 years is $0.83.	
	$1 Compounded at 4%	Yearly payments being 1.05 multiplied by number in preceding column.	$1 Compounded at 5%	Yearly payments being .83 multiplied by number in preceding column.
1	1.0000	1.0500	1.0000	.8300
2	1.0400	1.0920	1.0500	.8715
3	1.0816	1.1357	1.1025	.9151
4	1.1249	1.1811	1.1576	.9608
5	1.1699	1.2284	1.2155	1.0089
6	1.2167	1.2775	1.2763	1.0593
7	1.2653	1.3286	1.3401	1.1123
8	1.3159	1.3817	1.4071	1.1679
9	1.3686	1.4370	1.4775	1.2263
10	1.4233	1.4945	1.5513	1.2876
11	1.4802	1.5542	1.6289	1.3520
12	1.5395	1.6165	1.7103	1.4195
13	1.6010	1.6811	1.7959	1.4906
14	1.6651	1.7484	1.8856	1.5650
15	1.7317	1.8183	1.9799	1.6433
16	1.8009	1.8909	2.0789	1.7255
17	1.8730	1.9667	2.1829	1.8118
18	1.9479	2.0453	2.2920	1.9024
19	2.0258	2.1271	2.4066	1.9975
20	2.1068	2.2121	2.5270	2.0974
21	2.1911	2.3007	2.6533	2.2022
22	2.2788	2.3927	2.7860	2.3124
23	2.3699	2.4884	2.9253	2.4280
24	2.4647	2.5879	3.0715	2.5493
25	2.5633	2.6915	3.2251	2.6768
26	2.6658	2.7991	3.3864	2.8107
27	2.7725	2.9111	3.5557	2.9512
28	2.8834	3.0276	3.7335	3.0988
29	2.9987	3.1486	3.9201	3.2537
30	3.1187	3.2746	4.1161	3.4164
31	3.2434	3.4056	4.3219	3.5872
32	3.3731	3.5418	4.5380	3.7665
33	3.5081	3.6835	4.7649	3.9549
34	3.6484	3.8308	5.0032	4.1526
35	3.7943	3.9840	5.2533	4.3602
36	3.9461	4.1434	5.5160	4.5783
37	4.1039	4.3091	5.7918	4.8072
38	4.2681	4.4815	6.0814	5.0476
39	4.4388	4.6607	6.3855	5.3000
40	4.6164	4.8472	6.7048	5.5650
		$99.7769		$100.2637

This table serves well to illustrate the material influence of compound interest accumulations, for we find in the cases here given that in the 4 per cent fund the principal, or sum of annual payments, is only $40 \times 1.05 = 42.$

While the interest accumulations $= 58.$

$100.$

In the 5 per cent fund the principal is

$40 \times .83 = 33.20$

while the interest accumulations $= 66.80$

100.00

Mr. Henry Floy has recently presented to the American Institute of Electrical Engineers a paper entitled, "Depreciation as Related to Electrical Properties." This paper is a valuable contribution to the bibliography on this vexed question, and I recommend you to study the paper and the discussion which it will undoubtedly call forth, all to be found in an issue of the transactions yet to be published.

Mr. Floy has granted me the privilege of reproducing from his paper a plate which gives the workings of the sinking fund for three rates of interest, 3, 4, and 5 per cent. (See page 572.)

Mr. Floy's explanation of his plate is as follows:

"As 3, 4, and 5 per cent are rather common rates of return on funds allowed to accrue with interest, the curves on the accompanying plate are given, indicating the values in percentages that obtain at any given time for apparatus having lives varying from 5 to 100 years. The abscissa graduated from 0 to 100 indicates the age, the ordinates 0 to 100 indicate either the percentage of depreciation to be subtracted from the cost to obtain theoretical present value or the percentage of the original value direct. To use the curves, start from a point on the abscissa indicating the life already expired, follow the vertical until it intersects with the curve marked with the assumed life of the property being considered, then follow the horizontal to the left and read from the

ordinate the percentage of depreciation or the remaining present value as may be desired."

It will be seen that by drawing a straight line from the two points connected by any of these curves, we have the "straight line," or full cost of depreciation, for the several expectations-of-life covered by the diagram.

Before closing the chapter on "theoretical" or estimated accruing depreciation, a few words may be said on appreciation as offsetting depreciation.

Sometimes the increased value of real estate will compensate for the decreased value of plant due to depreciation; but it should be manifest that any assumption to this effect cannot be made in advance safely. This is an illustration of the element of speculation which, with or without our consent, finds a place in every business venture, and tends to complicate our estimates as to the future. In the case of real estate the chances are in favor of an increase in value, but this increase may be more than needed to offset other conditions which have developed unfavorably.

The value of the business as a "going concern," including perhaps franchise and good will, may so appreciate as to compensate in part or wholly or even more than compensate for accrued depreciation of plant. But here again we cannot safely make such an assumption, especially in the case of public service corporations subject to the control of commissions, some of which find it difficult to allow, in opposition to an uninformed and prejudiced public opinion, that property and rights in property may extend far beyond the limits set by physical assets.

In taking over a property or group of properties, the accrued depreciation should be covered in the purchase price. The plant may be in need not only of repairs but of extensions. Then the cost of repairs, renewals, extensions and improvements should be estimated most carefully and included as part of the purchase cost.

To carry on the business economically after purchase, the plant must be put into condition for thoroughly efficient operation. Having estimated carefully the cost of the required restorations, extensions, and improvements and added this to the purchase

price, it remains to be determined whether the total cost so found is warranted by the reasonably certain prospective profits.

But here it is to be borne in mind most carefully that if we include rehabilitation of plant as part of cost and cover the total cost by capital obligations, we should *at once* set up a scheme to cover the depreciation to accrue on the plant as a whole. It may be claimed that with a new or rehabilitated plant this depreciation does not commence at once; that the plant may even improve in efficiency or service value for a certain length of time depending upon how long it takes to "find itself." If this factor is to be considered, as it well may be in certain cases, it is better to introduce it as one of the factors in developing the expectation-of-life table than to delay in starting the depreciation fund. As in many other situations there is danger here in delay.

It is possible that the results obtained from the business, as shown by a competent analysis of the books of account and other records, would show an inadequate rate of profit on the proposed enlarged capital. Here we are warranted in giving some weight to a conservative estimate of the increase in profits to be expected from the improved plant and improved management of plant and business. It can be seen, though, that this may become a dangerous element in the financing of schemes of reorganization and consolidation. The investing public, and to a less extent the bankers who purchase the securities in the first instance, are dependent upon the estimates of cost of improvements and of increase in earnings furnished by the experts employed.

This subject is too large to be covered in this brief and necessarily incomplete course on the business side of engineering, but I have said enough to show that the technical expert, to be relied upon safely first by the banker and then, through the banker, by the investing public, must be thoroughly competent, technically and commercially. But this is not enough—he must be honest and have the courage of his convictions; he must be strong enough to express his real convictions when tempted to profit by the misrepresentation of facts or by the telling of half truths.

Through the underestimating of the cost of rehabilitation and extensions, and the overestimating of the profits to be derived

therefrom, there have been too many cass of illegitimate profit to the promotors with accompanying loss to the innocent investors.

See to it that none of you, either through ignorance or design, are responsible for so deceiving those placing their faith in you. In this connection there is resting upon you a professional responsibility as great as that resting upon the doctor and the lawyer; for remember there are many ills worse than death which may follow in the train of wrecked fortunes.

Finally, in regard to accruing or theoretical depreciation, let it never be forgotten:

1. Any expectation-of-life table employed in estimating probable or possible accruing depreciation must be based of necessity upon competently informed judgment.

2. Then it follows that the expectation-of-life table should be corrected and amended from year to year as dictated by changes in limiting conditions.

3. The life estimates must be based upon consideration of probabilities as to obsolescence, inadequacy, and physical decay. While accidents or sudden damage cannot be measured in advance, their possibility is not to be forgotten.

4. Electrolysis in some cases will be a loss factor even though we cannot estimate the amount of the loss.

5. The theoretical depreciation due to obsolescence, inadequacy, and physical decay will depend in large measure upon original design and construction.

6. Repairs and current renewals must be considered fully in estimating the probable cost of accruing depreciation; and all other things being equal, the more completely and competently the plant is maintained by current repairs and renewals which, as far as possible, eliminate obsolescence and inadequacy as well as physical decay, the smaller should be the annual charge to meet accruing depreciation.

7. In the expectation-of-life table each part of plant must be considered by itself and grouped accordingly; and each group of parts of plant must be provided for as to renewal and each

repeated renewal within the period set by the longest life included in the table.

8. The cost of accruing depreciation should not be confused with figures obtained by considering the financial methods to be employed in caring for depreciation loss. In any case the estimated annual loss with be the *net cost divided by the years of estimated effective service.*

9. If the loss is covered by a sinking fund, then the interest accumulations must be recognized as part of the cost, as shown by the table above,—"Result of company operating its own Sinking Fund."

10. In analysing and comparing several unit costs of accruing depreciation, the respective accounting methods employed must be understood and adjustments made accordingly.

11. Even in the case of undertakings which employ a uniform system of accounts, when comparing given unit costs of depreciation, variations, avoidable and unavoidable, in applying the system will tend to affect the accuracy and reliability of the comparisons.

12. These points accepted, it is evident that expectation-of-life tables and estimates of accruing (theoretical) depreciation based thereon, cannot be used to determine the present absolute or actual depreciation as found in the appraisal of properties.

DEPRECIATION

Actual Depreciation

As we have already seen, in considering questions involved in depreciation a strong line of demarcation is to be recognized between the problem of estimating the probable or possible future cost of depreciation as an annual loss item, and the determination of the actual depreciation which has already taken place in a plant under inspection.

The first is theoretical depreciation; the second is actual depreciation. If, year by year, the annual cost of plant renewals were about the same per cent of the cost of the whole plant, and if by the experience of a series of years it were found that there was no further depreciation accruing against plant investment, there would be no necessity for estimating theoretical depreciation or charging therefor to operating cost. This is the condition in some large systems made up of many plants built at different times. This may well be true in the case of extensive railroad systems, telegraph and telephone systems, and the like. But if the charges for plant renewal vary widely from year to year, and especially in the case of the early years of a single plant, theoretical depreciation should be estimated so that the annual loss therefrom shall be included in Loss and Gain Account before the balance of profit or loss is shown.

As we have seen, this necessarily is an estimate based in each case upon certain conditions discoverable by expert examination and certain assumptions made upon expert judgment and experience.

It would not be reasonable to expect that such an estimate, *closely adhered to through a number of years without amendment,* would then be found to have covered exactly the actual depreciation. Such a close agreement between the original estimate and the final result could only be by accident, particularly as the estimate should be made liberal enough to cover contin-

gencies. Some of the conditions in control when the original estimate was made would undoubtedly have changed as time went on, especially so in connection with changes in management. But if we attempt to determine the actual depreciation of a plant in operation by the application of a life table used years before as the basis for an estimate of theoretical depreciation, we are assuming that this original life table is correct.

If such an assumption is unjustifiable in the case of an estimate of theoretical depreciation applied after the lapse of a number of years in determining the actual depreciation of the plant *for which the estimate was made,* how completely indefensible for such a purpose is the application of a life table developed either by averaging data compiled from widely varying conditions, by widely varying methods, or by arbitrarily assuming that a life table based upon certain specific conditions can be made available for general application? And yet it is one of these last two methods which is employed by the experts who rely upon life tables in estimating actual depreciation in connection with the making of appraisals. Naturally they claim that they have introduced corrections and modifications to meet the specific conditions encountered, but they find it difficult under competent cross-examination to justify this claim.

A source of disagreement between estimated and actual depreciation, not readily recognized by theorists who have had little or no practical experience, is found in the insufficiency of some of the schemes of classification. A still greater source of disagreement is often found in the difficulty experienced in exactly complying with the requirements of even a well-planned scheme of classification, and especially in connection with items involving both repairs and improvements and so requiring a nice discrimination between operating cost and capital investment. Not infrequently we find, where the practice in such cases is to charge liberally to repair accounts and correspondingly favor improvement accounts, that the cost of all accruing depreciation is fully covered.

This is well exemplified in the practice of certain British gas companies which advisedly classify their expenditures thus

liberally against repairs and current renewals for the express purpose of covering accruing depreciation.

Let it then be understood that items of expenditure which by a strict compliance with the rules of classification should be charged to betterments and extensions, if charged in sufficient amount to operating cost through the repair accounts, can be so made to compensate for all accruing depreciation due to obsolescence, inadequacy, and physical decay.

While I advocate charging to repairs (operating cost) if finally in doubt, I do not advocate a deliberate departure from the scheme of classification; but if such a practice has prevailed in connection with a plant under examination, we should be prompt to recognize the fact and make due allowances therefor.

A superficial consideration of these features of our subject should be sufficient to convince those who in any degree preserve on open mind how indefensible is the position taken by certain engineers, statisticians, and accountants in assuming that an annual rate of depreciation as found in a table of averages can be applied to specific cases.

Some of these men, who unfortunately exercise such a dangerous influence to-day in connection with the conduct of our public utilities, go so far as to claim that all gas works (as an example) should be charged with a certain uniform rate of annual depreciation. Others, not quite so ignorant or not quite so unfair, claim that it is allowable to assume that certain parts of a gas plant should be charged with a certain uniform rate of depreciation. They might as well claim that a suit of clothes made of shoddy promises as long a life as a suit made from the best woolen cloth; or that two suits of clothes of the same quality would have the same life irrespective of the wear to which they are subjected and the promptness and thoroughness with which they are repaired.

I wish, then, to warn you men with all possible emphasis against being led into this error of accepting any general depreciation percentages whether for the determination of theoretical or actual depreciation.

And I also wish to warn you that you must be prepared,

through a full appreciation of and a firm grip upon the underlying common sense of this most important subject, to disprove false claims based upon incorrect data and upon correct data when unfairly analysed and speciously presented. Here you must be prepared to encounter men who make a specialty of appraising properties at the lowest plausible values, and who get the opportunities to earn liberal fees because of the reputations they have established for cleverness and adroitness on the witness stand in drawing at will widely varying conclusions from the one collection of data.

To assist further in combating the fallacies so ably presented by these advocates of destructive policies, fallacies too readily and willingly accepted by many in authority, I shall endeavor to show by additional illustrations the distinction to be made between theoretical and actual depreciation.

If we were asked to state the actual cost of construction of a certain plant, would we refer to the estimate made before the construction was begun, or would we consult the accounts which record the actual expenditures, including the cost of preliminary estimates and surveys, items actually forgotten and so omitted from the estimate, contingencies not provided for, and many overhead charges, such as interest during construction, accident and liability insurance, legal expenses, engineering and supervision—items so frequently ignored or insufficiently covered in engineers' estimates? The question answers itself.

If we were disposed to guide ourselves by an estimate of depreciation made twenty years before, would it not be incumbent on us as fair and intelligent men to check up the operations of those past twenty years to determine whether the conditions incorporated in the estimate, actual and assumed, including in every detail the methods of accounting necessarily a factor in every estimate of accruing depreciation, had been in control throughout the whole twenty years?

But why undertake such a burdensome task when the facts are available and can be authoritatively interpreted by those sufficiently trained in the theory and practice of the particular industry concerned?

Let it now be understood that the two elements of depreciation most difficult to cover in an estimate of theoretical depreciation are obsolescence and inadequacy. With this in mind, suppose we are appraising the distribution system of a gas company. Then those two elements are quickly and accurately disposed of by expert examination of the plant as far as exposed, and by investigation of the methods of operation, particularly as to maintenance. If the mains are standard cast-iron pipes, obsolescence is disposed of because they represent good modern practice. A study of the general layout and size of mains, the maximum output and prospects of immediate increase, together with the records of pressures throughout the system, enables us to determine the question of adequacy. The only element remaining is physical decay. This is more difficult to determine than it was some years ago because of the injury to mains and service pipes now being caused in certain localities by electrolysis. According to a modern theory all rusting of iron under ground is due to electrolytic action; but I am now referring to the electrolysis due to stray currents from electric power plants. Before the advent of electric traction, when this destructive agency entered into the problem, cast-iron pipes, as properly laid in most soils and left undisturbed in their beds, might have been considered as practically indestructible. But while we no longer have such favorable conditions, and electrolysis must now be reckoned with, the injury to an underground distributing system due to this cause is not quite so difficult to estimate as it was some few years ago; and by competent electric surveys the portions of the system most affected can be located and the measures required for correction can be taken advisedly. The examination for appraisal can determine whether these steps have been and are being taken regularly, and if not a complete survey can be made. The examination should determine whether the expenditures for repairs have been charged to operating expense, or preferably to a suspense account upon which to base a claim against the electric company responsible for the damage.

As I am writing I have before me for consideration a case which will serve by way of illustration. An expert for a certain

city engaged in a controversy with the local gas company, an engineer of excellent reputation and experienced as a constructor of industrial buildings and certain kinds of plant, but inexperienced as a *constructor and operator of gas plants,* made an appraisal of the gas company's plant, and, guiding himself largely by considerations of theoretical depreciation, his total valuation was less than one half that of the gas company's appraisers. From his reproduction cost of the cast-iron mains he deducted 25 per cent for depreciation. As already shown, there was no basis for deduction on the score of obsolescence. In this particular case inadequacy was eliminated because the mains were of ample capacity to distribute efficiently more than double the maximum output. There was no contention on the score of either obsolescence or inadequacy. This left only physical decay to be considered. In some few localities the main had been damaged by electrolysis, but the proportion of such pipe was extremely small. The test holes were put down at points agreed upon as likely to furnish an average of the condition as a whole, and pipes which had been laid for forty and fifty years were found to be practically as good as the day they were laid. It was shown that competent electrolysis surveys had been made and great care had been and was being exercised to repair and renew the mains affected and to maintain the whole system in thoroughly serviceable condition.

As bearing upon another feature of the appraisal and one of great importance, the city's expert failed to include as part of the cost of reproduction the cost of pavements which would have to be removed and replaced in reproducing the distributing system. Still worse, he omitted the cost of the pavement which the company had actually removed and replaced when laying its mains and services. Even if there is room for question as to the inclusion of the cost of all paving as found at the time of estimating *cost of reproduction,* which I claim should be included, there can be no question that the cost of the pavement actually taken up and replaced by the company should be allowed as part of the reproduction cost.

In the item of service pipes, made of wrought-iron, this

engineer was still more drastic in his treatment of depreciation. On this portion of the system he deducted 50 per cent. Here obsolescence and inadequacy were eliminated, for wrought-iron pipe, especially when efficiently coated as in this case, is modern practice. The pipes were ample in size and so adequate. As to physical decay, it was shown that the pipes were inspected, repaired and renewed as weaknesses were developed; and further, that in accordance with city regulations, whenever the pavement in a street was to be renewed, or a new pavement to be laid, the services had to be inspected thoroughly, and recoated or renewed as found to be necessary. Thus, notwithstanding the fact that this portion of the plant was maintained in accordance with the most advanced practice, the investment therein was cut in half.

This engineer was persistent in his inquiries as to the age of the component parts of the distributing system—as he was of the parts of the manufacturing plant—and evidently guided himself as to depreciation largely by the age of each part. It was somewhat of a shock to the age theory when it was discovered that some of the pipes which at first were taken to be of tender years because they were found to be in such good condition, were shown to have been laid a half century before.

Let us consider how this application to actual depreciation of the life-table method as used in estimating theoretical depreciation would work out in the case of these service pipes if another appraisal were made some years in the future.

Suppose at the time of the later appraisal the average age of these particular services were found or taken to be double the age assumed in the former appraisal, the plant in the meantime to have been maintained systematically and thoroughly as in the past. Many of these particular services will have been renewed, and a not inconsiderable number will be practically new at the time of the later appraisal. Under these circumstances this portion of the system should be found to have a service or operating value equal to its service value at the time of the former appraisal. And yet, if the second half of the assumed life has elapsed and the same rule is applied, another 50 per cent must be deducted for depreciation. Consequently these particular service

pipes must be inventoried as of no value and hence not to be capitalized, although thousands of gas consumers are being supplied through them in a way satisfactory both to seller and buyer.

In this same appraisal the consumers' meters were depreciated 25 per cent, notwithstanding the fact that they were found to be maintained by means of a system of constant inspection, repair, renewal, and condemnation under the eye of a Public Service Commission inspector, the complete round of all the meters being made every five years, all as described in the previous chapter on theoretical depreciation. It would be difficult to conceive of a plan better calculated than this to care for theoretical and actual depreciation.

In appraising the manufacturing plant the same heavy deductions were made for depreciation, chiefly on the score of age. One item will serve as an example—a certain station meter. This is the apparatus employed to measure the volume of the finished gas before it passes to the storage holders. The case of this meter was made of cast-iron. As originally built the drum was of the four-partition type. The city's expert admitted that the cast-iron case or shell was not depreciated. As to obsolescence the four-partition drum might be considered as not up to the best modern practice. As to inadequacy, the meter was of ample capacity for the service required of it. As it happened, this meter a short time before the appraisal had been reconstructed, the old four-partition drum had been replaced by a new "Hinman" three-partition drum, which brought the apparatus as a whole up to the most modern practice and, at the same time, considerably increased its capacity. By these repairs and changes, the meter was from every standpoint made of greater value than on the day it was first installed. And yet this part of the plant was depreciated 10 per cent. Some portions of the plant were given no value on the score of obsolescence, this engineer having heard of other forms of apparatus for the same service which he understood were more modern, although the apparatus he had thus condemned was in satisfactory use the world over and par-

ticularly recommended by some because of its simplicity of construction and operation.

The above case shows the errors into which an engineer may fall who is thoroughly honest in his intentions, is competent as a constructor of certain kinds of plant and a safe adviser along those lines, but inexperienced in the specific line of construction and operation in which he ventures to give expert testimony. This expert probably had not studied the question of depreciation from the standpoint of the operator, and as a constructor was imbued with the idea that second-hand plant is necessarily depreciated in value, and the greater its age the greater the depreciation. He was also acting under certain rules laid down for him, requiring him to omit from his inventory all plant not found to be in operation at the time of the appraisal; an instruction which an operator familiar with the conditions would have refused to recognize, knowing that surplus capacity plant must be held in reserve for wide and sudden fluctuations in output.

Now we come to a case of so-called expert testimony of very different character. I have said that in the case just narrated the engineer intended to be honest. Let that suffice. This case also involved an appraisal which was made in connection with a rate-fixing case. Two experts acted for the city. I am sorry to say both of these men had been professors in two of our important universities. One had been a professor of economics and the other of engineering. The first was in no sense an engineer; he had had no experience in the construction or operation of gas properties, but had saturated himself with gas statistics and data which he used with great facility and ready inconsistency. The other had had some little experience in gas engineering, most of which dated back about thirty-five years to the time immediately after his graduation. He also was an adroit manipulator of statistics and data as required to meet each case in hand.

The ex-professor of engineering inventoried the plant and assumed to appraise its value new on the basis of cost of reproduction. In adopting unit prices for material and labor he allowed himself a conveniently wide range of market conditions. Sometimes he used present market prices, sometimes those of five or

ten years back, and sometimes prices averaged through a number of years.

The ex-professor of engineering having thus produced what he was pleased to describe as the cost of reproduction of the manufacturing plant, the ex-professor of economics took up the story to show what should be deducted for depreciation. He made his computations solely on the age basis, avowedly disregarding the actual condition of the plant. In fact, he could not have taken the present condition into consideration as he did not pretend that he had examined the plant in detail, and by cross-examination it was shown that he was unable to describe the operation of many of the simplest parts of the manufacturing plant. In fact, the engineer professor was also found to be somewhat deficient in this regard.

The depreciation expert started off by quoting Alex. C. Humphreys as having testified about ten years before in the Holyoke Gas case that a (any) gas plant would have an "average life" of forty years. He then proceeded to testify that from such information as he had been able to gather the average *age* of the plant under consideration was twenty years. Hence the value was reduced one half. It is thus seen that the amount to be deducted for depreciation was found by an extremely simple arithmetical calculation. At least this gentleman's process of estimating depreciation should be commended for its lack of complexity.

But by cross-examination of this witness and by testimony for the Gas Company it was shown:

First: That Alex. C. Humphreys had not so testified in the Holyoke or any other case, but that the "life-table" developed in the Holyoke case was based upon the conditions there and then found; that it was only intended for use in estimating theoretical depreciation; that it was only so employed in that case; that the printed report of the case showed that the witness had repeatedly stated under direct and cross-examination that no general or average life figures could be used independently of local and other specific conditions; and that he had directly and emphatically testified that such a life-table could not be used in deter-

mining actual depreciation but that such a determination must be made from the facts and condition of plant as found by examination.

Also that Alex. C. Humphreys had never testified that a life-table developed for a specific case could be applied to other cases, and that he had never testified that in any case could a life-table be used to estimate actual depreciation.

Second: In this particular case the estimate of depreciation fell to the ground because the assumption as to age of plant was not well taken, and so the calculation was in error even if the forty years average life could have been made to apply. It was shown that the manufacturing plant had been largely rebuilt only a few years before and thus its "average age" had been reduced far below twenty years.

I have taken time to cover these two cases at some length because they serve well to show what should and should not be done in estimating actual depreciation in connection with appraisals of physical property; a matter of tremendous importance to proprietors and engineers in view of the radical demands now being made to satisfy public opinion in connection with the control of public utilities. The serious differences of opinion even between honest and thoughtful men cannot be removed until an agreement is more nearly reached as to the real significance of certain terms as, for instance, value, worth, cost, earnings, net earnings, profits, net profits, depreciation, reproduction costs, reproduction cost less depreciation, etc. One thing we must appreciate, value is relative and not absolute. A piece of furniture bought yesterday, barring accidents, is as valuable *to me* to-day as it was yesterday, and possibly my admiration for it has increased so that it has increased in value to me. But to the dealer it is second-hand and his value, even for sale, will show a large discount from the price paid yesterday. Its service value also to me may have increased because I have found by trial that it more completely meets my needs than I had at first supposed. The public's interest in the plant of a Public Service Corporation is its service value; its capacity for efficient and economical service.

The subject is too broad to cover at this time, but I can make one suggestion which is applicable in this discussion and in the discussion of all technical questions. If you have any reason to think that there will be any question as to the meaning you wish to convey by the use of a certain term, use words enough to define the term as you employ it. In writing these notes I have tried to guide myself by this rule, which may account for some repetitions, and yet I feel sure I have not always lived up to the rule.

To me it is clear that in appraising the physical portion of a property to determine its measure in capital, no further deduction for depreciation should be made than is measured by the cost of restoring the parts to their full efficiency for production, and therefore that its condition as to obsolescence, inadequacy, and physical decay and not its age should determine the deduction, if any, to be made. If there is an accrued depreciation in excess of the actual depreciation found as above, the cost of renewal must be paid for from income. In the long run no injustice is so done to the consumer of the product, because the consumer, first or last, should pay for the maintenance of the plant at its original cost, provided the profits, whether paid out in dividends or carried into surplus, are not found to be unfair; which is the very question at issue and to be determined in these rate cases.

If there is a reserve for depreciation which has been created by *charging to operating cost,* such reserve should be deducted as accrued depreciation.

In the appraisal of a plant to determine the investment upon which a "fair return" (whatever that may be determined to be—varying with the general and local conditions) is to be calculated, it is not by any means clear to me that there should be any deduction for depreciation *provided the plant is found to be in a condition to render efficient service to the public.* Certainly no such deduction should be made if the income has not been sufficient to maintain the plant, provide for accruing depreciation, and afford a fair return on the investment.

I have been reminded that this question is one of law rather than of expert opinion. It is then to be borne in mind that law

is largely built on expert opinion, and unfortunately it is too often wrongly built on defective expert opinion.

Many defective decisions have been rendered by the courts because those who have been relied upon to furnish expert advice have been either incompetent or unfair or both. Certain it is that great injustices have been done by decisions rendered by our courts in the last few years; these decisions having been based upon misleading evidence furnished by experts and the inability of the judges through unfamiliarity with the questions at issue to estimate correctly the relative weight of conflicting evidence. Laymen, certainly including engineers familiar with the principles involved, may feel at liberty to hold an opinion opposed to the law of the moment when they find courts of first instance reversed by the next higher courts, and these courts in turn reversed by the courts still higher; also when they find the highest court of the land, the Supreme Court of the United States, finally determining what is the law by a bare majority vote. Also when they find in some later case, the majority then reversing the majority in a previous case.

In these involved questions, and especially in connection with such matters as we have been discussing, where opinion is still in a condition of flux, when we are told that so and so is the law, we may venture to suggest that this is an opinion as to the law which is to be respected only until some higher authority reverses this opinion.

Those of us who have studied decisions rendered in certain cases, even cases before the United States Supreme Court, perhaps being familiar with the evidence and competent to judge as to the relative weight of conflicting expert evidence, have been convinced from the wording of the decisions that the evidence had been in part ignored or had been misinterpreted or not even understood.

Much has been said in condemnation of experts and expert evidence and much of this criticism has been deserved. As a remedy it has been suggested that the expert should be a court officer and that only this one expert should testify or advise the court on the technical points involved. This appears to have much

to recommend it when we study some of the evidence given by experts. But, on the other hand, the very conflict of opinion and interpretation of data and facts, as voiced by opposing experts, open up to the court the questions at issue as nothing else could. In other words, the present system with all its weaknesses, gives the court at least the opportunity to see both sides of the question at issue, provided, of course, that the experts and counsel on both sides are competent.

With these thoughts in mind I venture then to suggest that in connection with rate-fixing cases, depreciation should not be deducted from plant value provided the plant is sufficiently efficient to give satisfactory service to the consumer; and this though the opinion may be for the moment in opposition to the weight of opinion as to what is the law.

Certain it is that the law as interpreted by our courts to-day is very different from what it was supposed to be by the interpretation of these courts ten and even five years ago. Business men who to-day are liable to criminal prosecutions for what are now declared to be breaches of the law, made themselves thus liable while acting under the instruction of some of the ablest and fairest lawyers of the country. Some of these legal advisers, among the ablest if not the fairest, are now active in prosecuting the very men who made themselves liable under the law while under the guidance of their present prosecutors. The prosperity of the country as a whole is threatened by the general tendency, in answer to public clamor, to attack vested interests. The public fail to recognize, as they must sooner or later, that rich and poor are interested in capital, directly and indirectly; and the public and its law-making representatives fail to appreciate that the cause of true reform now requires constructive instead of destructive law making.

We may reasonably hope that there will soon be a reaction in favor of a saner general tendency. A great injury has already been done and more must follow before normal conditions can be restored. While recognizing and striving for the ideal, we must recognize the impossibility of attaining perfection through human agencies.

It is a fact to be deplored that while much has come from our colleges and universities which has been helpful in the cause of true and honest reform, much has also come which has misled and deceived. Certain professors of sociology and economics, theorists and idealists, lacking practical experience, have assumed and been allowed to direct in connection with economic and administrative questions of the gravest moment. Many of these men would be found incapable of earning a fair living as actual producers in the very lines in which they assume to occupy a position of leadership.

Too many of our daily papers and magazines have also been at fault in attempting to reform before learning the actual conditions in operation. Our militant reformers are now preaching the doctrine of efficiency. Here again we find an example of the loose use of terms to which we are so prone. The term as used by these people should be taken to mean as it does in engineering—the ratio of the useful work performed to the energy expended. Then we may say, "Physician, heal thyself," for the energy they have expended is out of all proportion to the useful work they have performed.

We may go farther and express the fear that their results destructive far outweigh those constructive. Good has been wrought, but at a tremendous, unnecessary cost. How then do these men dare to preach the gospel of efficiency?

But I hear you saying, What has this to do with depreciation? If you do not see the connection now, you will do so later.

Having made reference to the law on the subject, before closing let me say that, whatever the law may be, there is no warrant in fact for confusing actual depreciation with theoretical depreciation. Actual depreciation, whether measured by the neglected maintenance only or by an estimate of all possible accrued depreciation, is to be determined, from the viewpoint of the constructor and operator, by expert examination in detail of the plant, and not by the application of estimates of theoretical depreciation derived from expectation-of-life tables.

DEPRECIATION

The Accountancy of Depreciation

In discussing theoretical or estimated accruing depreciation some incidental reference has been made to the recording of this item of expense on the books of account.

We may now consider more in detail the accounting steps to be taken in connection with this subject.

First, we assume that a Repairs Account is kept, into which are charged the expenditures from current income for the repairs and minor renewals. In a scheme of classification which is designed to meet the requirements of a manufacturing business of any magnitude there should be a General Repairs Account, so divided and subdivided as to provide a separate or sub-account for each distinctive part of the plant. As the repairs are paid for during the fiscal period, Cash is credited and the proper sub-repairs account is debited; and so at the end of the fiscal period there is a debit balance found against each of these sub-accounts; for our present purpose these balances may be designated respectively as (a), (b), (c), and (d). At the end of the fiscal period the balance to the debit of each of these sub-accounts should be carried into the General Repairs Account, and this latter, together with the other loss accounts, should be closed into Loss and Gain Account.

For the sake of simplicity we will assume that there are only four such sub-accounts, referring to the steam plant, electric plant, machine tools, and buildings. As in this case the repairs have been debited through the cash-book, the first journal entry will be as follows:

	DR.	CR.
General Repairs Account, Dr.,	(a)+(b)+(c)+(d)	
To Sundry Repairs Accounts as below:		
Steam Plant Repairs Account,		(a)
Electric Plant Repairs Account,		(b)
Machine Tools Repairs Account,		(c)
Buildings Repairs Account,		(d)

Collecting the several Repairs Accounts in the General Repairs Account —closing the books for the (——months or year) ending this date.

The posting of the debit item, which is the sum of all the credit items, will carry into General Repairs Account the total amount expended during the fiscal period for repairs; and the posting of the credit items will close the separate repairs accounts, to be re-opened later as required to receive the debits of the succeeding fiscal period.

This journal entry will be followed by another journal entry as follows, or the item of general repairs will be included in the one journal entry transferring all loss items to the loss and gain account:

	DR.	CR.
Loss and Gain Account, Dr.,	(a)+(b)+(c)+(d)	
To General Repairs Account,		(a)+(b)+(c)+(d)

Transferring balance of General Repairs Account to Loss and Gain Account, closing the books for the (——months or year) ending this date.

It can be seen readily there is no narrow limit to the number of repairs accounts which may be opened. In common with other general accounts, General Repairs Account can be divided and subdivided as may be necessary or convenient for the analysis of cost and the apportionment of operating expenses in any required detail to the several parts of the plant or to the several steps in the processes of manufacture.

We will further assume that to these repairs accounts are charged certain of the more important renewals which have to be made at comparatively short intervals, such as the ties of a railroad, the poles of a telephone company, or the retort settings of a gas company. If the annual expenditures for such deferred renewals are fairly constant, there is no good reason for including such items in the estimate of accruing depreciation.

In the case of an extended industrial system, especially when made up of many separate complete plants, if the annual expenditures for repairs and renewals serve to maintain the system as a whole at its original cost, the renewals being so designed as to compensate for obsolescence and inadequacy as well as physical

decay, then we may go still farther and say there is no occasion for the estimating of any accruing depreciation or including that item in our accounts. In another connection I have shown before that some of the gas companies of Great Britain completely cover depreciation by liberal charging to current maintenance accounts.

Even in the cases where accruing depreciation is not completely offset by these current expenditures for maintenance, almost surely certain parts of the plant will be so covered. In such a case these parts should not be included in the expectation-of-life table or in the estimate based thereon. Were it not that this point is lost sight of too often by certain so-called experts and the authorities they advise and influence, it would not be necessary to draw attention to such an obvious truth. On the other hand, we must recognize that there is depreciation to be reckoned with; and, if it is not paid for currently, provision must be made eventually for it out of the income.

It is not sufficiently recognized that the problem in accounting as applied to depreciation is to spread the cost of maintenance of the several parts of plant with a fair degree of uniformity over the years which these parts of plant are in service, so that these loss items may not accrue too heavily against the income of any year.

If the renewals as called for year by year and paid for from current income meet this requirement, the problem is solved. In the case of a system made up of a number of complete plants, perhaps of widely varying ages and in different locations, if we consider the depreciation of the system as a whole, this condition might well obtain. It would not be likely to obtain in the case of a single plant, and could hardly do so if the plant were new. The final word is that we must be sure that the full investment in plant is maintained by one process or another.

We now come back to the case of a plant which is affected by accruing depreciation, the measure of this accruing or theoretical loss having been estimated as far as possible or practicable under the circumstances.

As it may be convenient to apportion the charge for repairs to the several parts of plant, so it may be convenient to apportion

the charge for depreciation. Let us assume that there is a separate depreciation account for each of the four divisions of plant —steam, electric, machine tools, and buildings; and that there is a General Depreciation Account into which the balances of the separate depreciation accounts are carried on their way to Loss and Gain Account. We will also assume that there is a separate asset or plant account for each part of the plant covered by a separate depreciation account.

A direct method of charging up depreciation, in favor with many until recent years, was to debit the estimated depreciation for the year to Loss and Gain Account and credit the amount to Plant Account.

For this method the journal entry in its simplest form would be as follows:

	DR.	CR.
Loss and Gain Account, Dr.,	$000.00	
To Plant Account,		$000.00

Estimated depreciation of plant for the year ending this date.

Suppose we decide to account for estimated depreciation by crediting to Plant Account; and instead of charging direct to "Loss and Gain" we prefer to charge to the separate depreciation accounts, and then to collect in the General Depreciation Account, and finally transfer from General Depreciation Account to Loss and Gain Account. Assume that the estimated depreciation of the steam plant is (e), of the electric plant is (f), of the machine tools is (g), and of the buildings is (h). Then the first journal entries would debit the separate depreciation accounts and credit the corresponding plant accounts, thus:

	DR.	CR.
Steam Plant Depreciation Account, Dr.,	(e)	
To Steam Plant Account,		(e)

Estimated depreciation of the Steam Plant for the (——months or year) ending this date.

And to consolidate the several depreciation accounts in the General Depreciation Account the journal entry would be something in the following form:

	DR.	CR.
General Depreciation Account, Dr.,	(e)+(f)+(g)+(h)	
To Sundry Depreciation Accounts as below:		
Steam Plant Depreciation Account,		(e)
Electric Plant Depreciation Account,		(f)
Machine Tools Depreciation Account,		(g)
Buildings Depreciation Account,		(h)

Collecting the several Depreciation Accounts in the General Depreciation Account—closing the books for the (——months or year) ending this date.

Then this would be followed by another entry to close Depreciation Account into Loss and Gain Account as follows:

	DR.	CR.
Loss and Gain Account, Dr.,	(e)+(f)+(g)+(h)	
To General Depreciation Account,		(e)+(f)+(g)+(h)

Total estimated depreciation of plant for the (——months or year) ending this date.

Thus, by either of these variations of this method, the book value of plant, as represented by the debit balance of this asset account (as a whole or subdivided), by the first credit entry or entries would be reduced to correspond to the estimated depreciated value. Then the expenditures as made for renewals and replacements of plant would be credited to Cash and debited to Plant Account instead of to repairs or renewals (operating cost), thus rebuilding the asset account of plant.

In this connection, because it has not been recognized by certain "experts," or if recognized has been ignored, let me point to another truth which should be obvious. If estimated accruing depreciation is debited to Loss and Gain Account through the proper operating accounts and is credited to Plant Account, when parts of plant so covered by the estimate are abandoned, the cost thereof should not again be charged to operating cost and credited to Plant Account.

This method of crediting depreciation to Plant Account would serve to represent plant on the books at its true cost *provided accruing depreciation were correctly estimated and provided*

allowance were made for the depreciation credited to Plant Account in advance of the renewals and replacements thus provided for.

As the amounts so credited to Plant Account to cover estimated accrued depreciation, in advance of the actual renewals and replacements, would be shown on the ledger only in the reduction of the debit balance of Plant Account, and so there would be no credit balance established to represent the accrued liability, it can be seen that this scheme, apparently so simple, is decidedly defective and does not provide for easy and prompt analysis. But another fault of this method of crediting *estimated* depreciation to Plant Account has been indicated. If this estimate is on the safe side, as it should be to cover contingencies, then Plant Account is being written down (balance reduced) to a point where it may not at any time represent fairly even its depreciated value. This is well illustrated in the practice of some of the old manufacturing concerns, especially in New England, which take advantage of prosperous years to debit large amounts for depreciation, arbitrarily determined, to Loss and Gain Account, crediting these amounts to Plant Account. In many cases this has been supplemented by paying for extensions and improvements from income and charging to repairs or other loss accounts. Frequently this course has been pursued until the debit balance of Plant Account has been reduced to a nominal sum, perhaps $100, the account being kept open only that the plant may be represented on the books, irrespective of its real value. In a lesser degree this practice has been followed by some of the Public Utility Corporations, so that the plant accounts do not nearly represent the cost of plant. Many of the gas companies of Massachusetts furnish an example of this practice.

In view of the opinion held by the uninformed public that all of our great corporations, and especially the Public Utilities, are carrying large percentages of "water," such a statement as this is calculated to excite incredulity in the minds of many, including some of the college theorists. If the proposal to appraise generally the value of our Public Utilities is realized and the work is performed honestly and competently, the public will be surprised

to find that the *physical* value of many of these properties, railroads especially, exceeds their capitalization.

As the "book value" of cost of plant is one of the elements likely to be considered in the valuation of the properties of public utilities, it is proper that these "book values" should not be written down by excessive charges to depreciation, arbitrarily determined. Such a course is doing the stockholders an injustice.

In the case of a private firm or close corporation, not subject to governmental control, where all the proprietors are advised of and consent to the policies pursued, and an ultra conservative policy in this regard is determined upon, the proprietors have themselves only to blame if harm results. As governmental control, in one form or another, appears to be spreading into all lines of industrial activity, it is important that the books of account of all corporations should show the facts as accurately as possible, neither for nor against the stockholders. Here it is to be borne in mind that the plant accounts can be taken and are taken by some as representing the company's full claim for original cost. Especially is this true in the case of those who are obsessed with the idea that all Public Utility Corporations are floating in "water." Then it is to be remembered that *cost* of plant is one of the elements to be considered in valuing a property. And it is by no means improbable that the courts may finally decide, in the case of plants which have been honestly and competently built, that, *as far as this element of property value is concerned,* cost is the final test. Assume now that the book value of plant has been reduced far below cost, the plant in large part has to be rebuilt from a depreciation reserve: If the rates for the product or service have been based upon this incorrect valuation, largely the result of incorrect account keeping, to afford a fair return, the rates will have to be increased when the plant is restored.

If there is a depreciation reserve it is fair to suppose that the reserve will be equal to the depreciation as estimated and hence if the plant is rebuilt from the reserve, the conditions remain unaltered. For in appraising, the depreciation of plant will be offset by the reserve if the reserve is represented by an asset.

We now come to another method of accounting for depreciation which keeps the facts more completely in view, and also gives more opportunity for revising the estimate of accruing or theoretical depreciation as the facts and circumstances from time to time suggest.

Instead of crediting the estimated depreciation to the General Plant Account or to the particular plant account involved, the amounts when debited to Depreciation Account (or direct to Loss and Gain Account) are credited to a liability account, which may be designated as Depreciation Reserve Account.

If the estimated depreciation were not divided up against the different portions of the plant, and the depreciation were charged up at the end of the fiscal period only, there would be no necessity for a depreciation account, as the amount could be debited direct to Loss and Gain Account and credited to Depreciation Reserve, as shown by the following journal entry:

	DR.	CR.
Loss and Gain Account, Dr.,	(e)+(f)+(g)+(h)	
To Depreciation Reserve Account,		(e)+(f)+(g)+(h)

Estimated accruing depreciation on plant for the (——months or year) ending this date, ——% on $000.

This entry when posted would carry the item of depreciation into Loss and Gain Account as one of the losses of the period, and as it is a loss not yet liquidated by the credit to Depreciation Reserve, the amount would be set up as a liability.

If it were preferred to pass this amount first through a Depreciation Account, the steps would be as shown below in the case of a General Depreciation Account divided into a number of subaccounts:

	DR.	CR.
Sundry Depreciation Accounts as below, Dr.,		
To Depreciation Reserve Account,		(e)+(f)+(g)+(h)
Steam Plant Depreciation Account, ——% on $000,	(e)	
Electric Plant Depreciation Account, ——% on $000,	(f)	
Machine Tools Depreciation Account, ——% on $000,	(g)	

Buildings Depreciation Account, ——% on
$000, (h)

Estimated accruing depreciation on several parts of plant for the (——months or year) ending this date.

This entry when posted would set up a liability in the Depreciation Reserve Account equal to the total depreciation, and would debit each sub-depreciation account with its share of this loss item for the fiscal period. These four debits (loss) balances could now be carried into the one depreciation account by the following journal entry:

	DR.	CR.
General Depreciation Account, Dr.,	(e)+(f)+(g)+(h)	
To Sundry Depreciation Accounts as below:		
Steam Plant Depreciation Account,		(e)
Electric Plant, Depreciation Account,		(f)
Machine Tools Depreciation Account,		(g)
Buildings Depreciation Account,		(h)

Collecting the several items of estimated accruing depreciation in the General Depreciation Account for the (——months or year) ending this date.

The posting of this entry would balance the sub-accounts and debit the total for all four accounts to General Depreciation Account. Then to carry this depreciation item into Loss and Gain Account as one of the loss items of the period the following journal entry should be made:

	DR.	CR.
Loss and Gain Account, Dr.,	(e)+(f)+(g)+(h)	
To General Depreciation Account,		(e)+(f)+(g)+(h)

Closing the books for the (——months or year) ending this date.

This entry when posted would balance General Depreciation Account and carry depreciation as an item of loss finally into Loss and Gain Account.

If it were the purpose to charge up the estimated depreciation only at the time of closing of the books, then there would be no actual necessity for employing the sub-accounts, nor in fact, the

General Depreciation Account, as the itemizing of the estimated depreciation could be shown in the journal entry, thus:

	DR.	CR.
Loss and Gain Account, Dr.,	(e)+(f)+(g)+(h)	
To Depreciation Reserve Account,		(e)+(f)+(g)+(h)

For the estimated accruing depreciation on the several parts of the plant for the (——months or year) ending this date, as follows:

Steam Plant Depreciation, ——% on $000,	(e)
Electric Plant Depreciation, ——% on $000,	(f)
Machine Tools Depreciation, ——% on $000,	(g)
Buildings Depreciation, ——% on $000,	(h)

If a Loss and Gain statement is made up each month and the required adjusting entries are made in the books each month instead of being made only on the statement, then it would be necessary to employ a Depreciation Account, and, preferably, also the sub-accounts. In that case, at the end of each month there would be made a journal entry similar in form to one already given, as follows:

	DR.	CR.
Sundry Depreciation Accounts as below, Dr.,		
To Depreciation Reserve Account,		$\frac{(e)+(f)+(g)+(h)}{12}$
Steam Plant Depreciation Account, ——% on $000,	$\frac{(e)}{12}$	
Electric Plant Depreciation Account, ——% on $000,	$\frac{(f)}{12}$	
Machine Tools Depreciation Account, ——% on $000,	$\frac{(g)}{12}$	
Buildings Depreciation Account, ——% on $000,	$\frac{(h)}{12}$	

Estimated accruing depreciation on the above several parts of plant for the month of ————.

The computation for this entry instead of being based upon one twelfth of the annual charge for depreciation might be based upon the *pro rata sales for the month as determined by the estimated sales for the year.* This last method is particularly appropriate in the case of companies selling gas or electric current.

This method would build up month by month the several depreciation debits and also the depreciation reserve liability.

At the end of the fiscal period the several depreciation accounts would be collected into the General Depreciation Account by one journal entry, and then by a second journal entry, the balance to the debit of General Depreciation Account would be transferred to Loss and Gain Account and the General Depreciation Account balanced. These entries would be the same as the ones already shown.

Or, at the end of the fiscal period, the one journal entry could be made to serve the purpose, namely:

	DR.	CR.
Loss and Gain Account, Dr.,	(e)+(f)+(g)+(h)	
To Sundry Depreciation Accounts as below:		
Steam Plant Depreciation Account,		(e)
Electric Plant Depreciation Account,		(f)
Machine Tools Depreciation Account,		(g)
Buildings Depreciation Account,		(h)

Closing into Loss and Gain Account the several depreciation accounts covering the estimated accruing depreciation—closing the books for the (——months or year or fiscal period) ending this date.

The final effect of these monthly debits to the several depreciation accounts and credits to "Depreciation Reserve," and the journal entry or entries at the end of the fiscal period, would be to debit "Loss and Gain" with the total estimated accruing depreciation for the period and to credit this amount to "Depreciation Reserve"; so establishing a liability equal to the loss charged against income.

It must now be understood that all of these methods in which Depreciation Reserve Account is employed lead to the same final result. This is to be fully understood before further progress can be made.

Another point must be understood. These journal entries have in no way affected the Cash Account. Certain cross entries have been made which have declared certain losses and charged them up to Loss and Gain Account; and as these losses have not yet been paid, we have set up a liability account to remind us that the loss has yet to be paid, and that this liability must be deducted from our assets.

This point can be made clearer by carrying the depreciation scheme one step farther.

Assume that the amounts reserved against estimated accrued and accruing depreciation are to be segregated in a Depreciation Sinking Fund; either by depositing in a trust company, there to accumulate at compound interest, or in a fund administered by the operating company through the purchase of securities, the interest on these securities also to be so invested.

First, we will assume the fund is to be administered by a trust company. Then at the end of the fiscal period the amount as debited to "Loss and Gain" and credited to "Depreciation Reserve" will be paid over to the trust company. The payment, being a cash transaction, will be entered on the *credit* side of the cash-book, something as follows:

Depreciation Sinking Fund—Consolidated Trust Co. (e)+(f)+(g)+(h)

This entry, as part of the total credit footing, will be posted at the end of the month to the credit side of Cash Account in the ledger, and will at the time of entry be posted to the *debit* side of "Depreciation Sinking Fund." This in no way changes the *credit* balance to "Depreciation" Reserve—that remains as before, showing the liability. Now the Depreciation Sinking Fund shows as asset equal in amount to the liability shown in Depreciation Reserve Account. Where the liability of "Depreciation Reserve" had to look before to Cash and the assets in general to meet its liability, there is now established a separate asset, set apart only to meet the one liability, the Depreciation Reserve Account.

We are to remember that the depreciation reserve, in the case of a sinking-fund scheme of financing, is dependent upon compound interest accumulations to make good the estimated accrued

and accruing depreciation at the times shown in the expectation-of-life table. These interest accumulations must appear on the books though they will be in the hands of the trust company together with the principal sums deposited at the end of each fiscal period. The interest accumulations will not then appear as cash transactions as far as the operating company is concerned. The facts then must be carried into the ledger through journal entries.

We will assume that the trust company, as it collects interest on account of the sinking fund, and so credits interest to the fund, notifies the operating company of the fact. A journal entry can then be made thus:

	DR.	CR.
Depreciation Sinking Fund, Dr.,	$000.00	
To Depreciation Reserve Account,		$000.00

For interest credited to Depreciation Sinking Fund by the Consolidated Trust Company for the period ending ———.

Or, if we prefer to keep the interest accumulations in a separate account, so that the rate of accumulation can be more readily checked, the journal entry may be:

	DR.	CR.
Depreciation Sinking Fund, Dr.,	$000.00	
To Depreciation Reserve Interest Account,		$000.00

In either case, as the reserve is increased, as it should be to meet the conditions included in the expectation-of-life table and the estimate based thereon, the asset account, Depreciation Sinking Fund, correspondingly increases.

Now assume that the operating company administers its own sinking fund through the purchase of securities. As the securities are purchased and payments made, Cash will be credited through cash-book entry and "Depreciation Sinking Fund" will be debited, as explained in the trust company case. The detailed record of the securities purchased, including rates of interest, dates when interest is due, etc., will be kept in a special book lettered and ruled for the purpose.

As interest is received on these securities the detailed record will be made in the special book and the cash entries will be made

on the *debit* side of cash-book, which, being posted, will go to the *credit* of "Depreciation Reserve Interest." As the uninvested interest increases, the fact will be indicated by the sum of the credit balances of "Depreciation Reserve" and "Depreciation Reserve Interest" exceeding the debit balance of "Depreciation Sinking Fund." When the uninvested interest as thus indicated has accumulated to sufficient proportions additional securities can be purchased. The payments therefor will be recorded on the credit side of the cash-book and so be posted to the debit side of Depreciation Sinking Fund Account. And so by the purchase of additional securities from the interest accumulations, the interest will compound and the liability accounts, Depreciation Reserve and Depreciation Reserve Interest will be balanced by the asset account Depreciation Sinking Fund, plus cash account to the extent of any small uninvested balance still remaining in Depreciation Reserve Interest Account.

From this discussion of some of the several ways of charging up for estimated accruing depreciation to Loss and Gain Account at the end of each fiscal period, it should be apparent that in general it is preferable to credit these amounts to Depreciation Reserve Account rather than to the plant accounts themselves. One reason alone should be sufficient warrant for this preference—the greater opportunity afforded to check up the estimate of accruing depreciation from time to time as facts develop; for it must never be forgotten that this "Depreciation Reserve" is based upon an estimate which is dependent upon many unknown quantities. Where there is maintained an adequate "Depreciation Reserve" balanced by a sinking fund or its equivalent, Plant Account, if kept on the basis of cost, can be taken at its face value and *no deductions should be made therefrom.*

You have now been shown that in addition to the many and serious difficulties to be met in attempting to estimate accruing or "theoretical" depreciation, there are other difficulties and complications in connection with the depreciation reserve and sinking fund method of financing this depreciation. This complexity can be further emphasized by considering the comparative simplicity of the process of amortizing by a sinking-fund scheme certain

definite payment to be made some years in the future; such as an issue of bonds falling due at a certain date; the premium paid on bonds purchased for investment; the improvements on leased land which must be surrendered to the landowner on the expiration of the lease, etc. Here in each case there is one definite amount to be paid at a certain known date.

As a rather instructive example, the case can be considered of amortizing the premium paid on bonds purchased for investment to be held until the bonds fall due. In this case there should be set aside in a sinking fund such a portion of the interest received on the bonds as, accumulating at compound interest, will at the time the bonds are redeemed equal the total amount originally paid in excess of the face value of the bonds. If this amortizing of the premium were not provided for and so the interest were all included in and treated as income and so expended, by the time the bonds were redeemed we should have impaired our capital to the extent of the total amount paid in excess of the face value of the bonds. Incidentally it may be pointed out that this does not apply to stocks, because they are not purchased under the provision that they will be redeemed at a certain date, but that they will remain as a liability of the company during its life. If the stock is purchased at a premium, it is hoped that it will continue to command an equal or a higher premium. Of course there is no guarantee to this effect, but that is the risk taken in connection with any purchase.

Before concluding the discussion of this part of our subject a few words may be said in regard to the accounting steps to be taken when renewals of plant are made as called for by the estimate on theoretical or accruing depreciation.

In the first place, it is highly improbable that the payments will be made in actual accordance with the expectation-of-life table. This failure of agreement between the table and the dates of payment should be observed carefully and the estimate of accruing depreciation corrected accordingly.

But assuming that the estimate is correct, then, for instance, as the parts of plant in Group A have to be renewed the amount required to pay therefor would be drawn from the sinking fund,

and when the payments were made for the plant as renewed, the debit would be to "Depreciation Reserve" instead of either to "Plant" or "Repairs." Assuming that the money were received from the sinking fund in the hands of the trust company, the cash received would be entered on the debit side of cash-book and from there posted to the credit side of "Depreciation Sinking Fund," so reducing the debit balance of the latter account. When payments were made for plant renewals, the items as paid would be entered on the credit side of cash-book and from there posted to the debit side of "Depreciation Reserve," so reducing the credit balance of the latter account. And so again the credit balance of "Depreciation Reserve" and the debit balance of "Depreciation Sinking Fund" would be kept in equilibrium by equal reductions of each account.

Now let us consider briefly the accounting steps to be taken if the amounts charged to "Loss and Gain" to cover depreciation are invested in extensions of plant instead of a sinking fund.

Here also we could assume that the sums so invested were to accumulate at compound interest, the interest in this case to be derived from the additional earnings received from the extensions of plant paid for from these amounts borrowed from the depreciation fund. To determine what should be the annual charge for depreciation it would be necessary to assume in advance a rate of interest to be obtained from the operation of these extensions of plant. Such a rate should be assumed as could undoubtedly be earned by these extensions. The actual earnings from these extensions would be difficult to segregate, and unless a rate were assumed independently of the facts to develop later, the amount of the annual charge for depreciation could not be determined in advance. Then from the earnings it would be necessary at the end of each year to credit the "Depreciation Reserve" with the annual sinking-fund payment and the interest on the total reserve.

A simpler way to arrive at this result, as already pointed out in connection with the table showing the increasing yearly payments through a forty-years' life, as required for a sinking fund maintained by the operating company, is to charge to "Loss and Gain" and credit "Depreciation Reserve" the full amount of deprecia-

tion without regard to interest. That is, for a ten-years' life, one tenth of the cost of plant, for a fifteen-years' life, one fifteenth, and so on.

The accounting steps to cover this case are the same as in the case before covered, up to the point of paying cash into the sinking fund.

Assuming that the several depreciation accounts are kept and that the depreciation is charged up at the end of each month, a journal entry would then be made debiting the several depreciation acounts with their respective portions of the estimated depreciation and crediting Depreciation Reserve Account with the total of these charges. At the end of the fiscal period General Depreciation Account would be debited with the sum of the balances to the debit of the several depreciation accounts and these several accounts would be credited with their respective balances. And finally, Loss and Gain Account would be debited and General Depreciation Account credited with the total estimated depreciation for the fiscal period.

When renewals were paid for as covered by the estimate of depreciation, Cash would be credited and Depreciation Reserve Account debited, so reducing the credit balance of the latter account.

I have stated that extensions and betterments as well as renewals might be charged against Depreciation Reserve Account provided these extensions and betterments were not capitalized, and as a general proposition this is true.

Two exceptions might here be noted:

Amounts taken from income and credited to Depreciation Reserve Account and invested in extensions and betterments may properly be capitalized by issuing bonds against such improvements, provided the bonds so issued are held as part of the depreciation fund, the proceeds of the bonds being used for the renewals as called for by the estimate of accruing depreciation. In this way the renewals and the improvements are not confused with each other, and there is not the same need for explanation later when money would have to be borrowed for renewals to replace the money borrowed from the depreciation fund for ex-

tensions and improvements. This has to do with the accounting only, as the result is the same either way, provided the facts can be presented to and understood by those in authority.

The other exception is one which goes much deeper and has to do with the law. While as a general proposition, especially with an established business in an established industry, depreciation should be met from income and should not be capitalized, there are exceptions. If a business is operated during its first years at a loss, or if it yields a profit which is insufficient to pay depreciation and a fair return, and provided this deficit has not been occasioned by dishonesty or incompetency, as far as the law is concerned this deficit can be capitalized, which means capitalizing the depreciation wholly or in part.

A notable example of this is found in the electric light and electric railway companies organized in the early days of the industry. So rapid were the advances in the art and consequently so great the losses through obsolescence, that these companies could not have met their depreciation cost from income except by charging rates for service which would have effectually prevented the commercial development of these industries. Where it has been necessary for the proprietors to meet the cost of apparatus superseded after only a very short life, and this in the interest of the public served, the latter should be required to pay the cost thereof through the increase of rates made necessary by the capitalizing of some of these losses. But we find the public and its representatives continually demanding increased facilities for transportation, greater convenience and even luxury, while also demanding reduced rates, although in many cases the existing rates are not sufficient to produce a fair return on the investment and the full cost of depreciation. The public and the representatives of the public also fail to appreciate how they have complicated the situation by giving franchises to competing companies, although these same representatives and the courts in deciding questions of rates do so on the theory that the Public Utilities enjoy a monopoly. And they should enjoy a monopoly if they are to be subject to regulation of rates. The fact is that the history of our Public Utilities has been one of struggle against

competition, permitted and even encouraged by the state and city legislatures through the granting of "strike" franchises. The public, through its representatives, rather than the proprietors, is responsible for the additions thus made to the capitalization of many of our Public Utilities.

In a recent case before a Public Service Commission for the fixing of rates to be charged by a company distributing electric current in one of the largest cities of the United States, the decision was against the company, although in the decision it was directly admitted that neither the city nor the Commission was able to protect the company against competition. In fact, at the time of the decision the company was in active competition with two other companies distributing electric current. This decision was rendered all the more unjust by the fact that the most important findings of the Commission were based upon the report of the Commission's chief engineer who was also a member of the Commission. This man's reports were addressed to himself as one of the three commissioners; and so, as a commissioner, acting in a judicial capacity, *he reviewed and passed upon his own report and recommendations.* The approval of this engineer-commissioner cut the appraisals of the company's experts in half, although the latter were men of ability and high standing. The appraisals of real estate included in the Commission's findings were directly opposed to the appraisals of local real estate dealers of standing and were in violation of accepted interpretations of law. Hearings were held by the Commission in secret and findings were had on the testimony of witnesses whom the company had had no opportunity to cross-examine. It is in the manifest injustice practiced by such men as this engineer-commissioner, whose one desire seems to be to play to the gallery, that the corporations may look for a reaction towards the fairness bred of sanity.

In another recent case another Public Service Commission attempted to protect from competition a company distributing electric current in another of our largest cities. The Commission decided that as the company's rates of charge were subject to the Commission's regulation, the company should be permitted to

enjoy a monopoly. In this case the consistent action of the Commission, upon appeal to the courts, was overruled. So it appears that my denial of the claim that our Public Utilities enjoy a monopoly (and so should be subject to regulation) does not depend for verification upon the history of the past alone.

If demands are made upon our railways, especially the city and suburban electric railways, for increased service involving increased expense, and depreciation plus a fair return on the investment cannot be covered by the existing rates, the passengers of the future must pay for the errors of the present or the result will be confiscation, wholly or in part. The public and many of the public's representatives, fail to recognize that in the final analysis, their interests and the interests of the proprietors of these utilities (the "public" in great part being the proprietors) are inseparably involved one with the other.

Before concluding this discussion of the accountancy of estimated accruing depreciation, let me in a word or two refer to still another way of treating this item of expense on the books of account, which can be considered here appropriately because at first glance it might be thought to be capitalizing the expenditures made against depreciation. Further consideration will show that this is not the case, but rather it gives the consumer the full advantage of the smaller payments for "Depreciation Reserve" as called for by the sinking-fund scheme.

Assume that "Depreciation Reserve" is borrowed from to meet plant extensions and improvements. Then it would be proper to capitalize these extensions and improvements, or debit them to Plant Account, so increasing capital as represented in the physical assets, provided interest is credited to the fund at the rate at which a compound interest sinking fund could be established. Thus the cost of depreciation would be reduced to the amount called for by a compound interest sinking fund, as already fully explained, and the company would be permitted to earn on the money so borrowed from "Depreciation Reserve" at the rate allowed to be earned on the property as a whole, say 8 to 10 per cent. The justice of this method can be seen more readily if we compare with borrowing from some outside source to meet these

extensions and improvements. In the latter case the company would borrow at as low a rate as possible, which, by reason of the assets and surplus earnings guaranteeing the loan, would be lower than the rate of return allowed to the company. Having so invested these borrowed funds the company should be allowed a return to the limit on this invested capital the same as on the capital previously invested. This practically comes back to the case of expending the "Depreciation Reserve" on plant extensions and improvements as well as on renewals and including all the plant in the inventory for appraisal. The plant displaced by the renewals will not be found in the inventory and so actual depreciation to that extent will be allowed for in the inventory.

We have now considered in some detail a number of the questions involved in the accountancy side of the complex subject of "theoretical" or estimated accruing depreciation.

Although it is in large measure repetition, I feel that it is advisable to remind you that these discussions of the perplexing questions considered have been from the standpoint of present exacting demands; but that in no case is there any fair warrant for applying to the operations of the past, estimates of accruing depreciation prepared for the future.

Especially is it indefensible to assess actual depreciation of the present on the basis of expectation-of-life tables not thought of at the time the plants were built, and not prepared to cover conditions, general and specific, then in control. In no case would this be a defensible method of appraising actual depreciation. It would not be so even twenty years from now on an estimate carefully and competently prepared to-day. Certainly, then, it is indefensible to apply such a method retroactively.

In the past there was a general lack of understanding of this subject; and furthermore, even if there had been this understanding, in many cases the demands made through the rapid development of the art involved and the local situation, would have effectually prevented the proprietors from complying with the requirements as generally enunciated to-day by Public Service Commissions and other authorities.

On the other hand, in certain industries, especially as developed

in certain parts of the country where the demands had settled down to a fairly normal basis, depreciation was more than provided for by the investment of surplus earnings in plant, without a corresponding capitalizing of these investments.

Even to-day the provision made against depreciation on the "straight line" theory, that is, reinvesting the full estimated cost of depreciation without regard to interest accumulations, should be considered as doing full justice to the purchasers of product or service. In fact, in some cases of undeveloped local undertakings and undeveloped arts as applying to all undertakings involved, it is yet necessary that there should be some allowance made for the capitalizing of losses, depreciation included, until the undertakings so develop that, at the rates of charge permitted, the proprietors are able to pay a fair return on the *total investment* after meeting all expenses and losses.

In view of these remarks, you may inquire why I have gone into the question of accruing depreciation in such detail.

For two reasons:

First, because many of you will be called upon to meet these questions understandingly in the interest of your employers; and

Second, because men graduating from Stevens Institute should be prepared to do their full share in guiding aright the development of the industries.

We now come to the consideration of the accounting steps to be taken in connection with actual depreciation.

Actual depreciation should be debited to Loss and Gain Account (directly or through Depreciation Account or a Depreciation Suspense Account) and credited to the proper Plant Account, provided it does not fall within one of the exceptions already noted. *Particular care should be taken not to so treat actual depreciation in the accounts if the items under consideration have been included in the estimate of accruing depreciation.* To illustrate this point I will again refer to the uniform system of accounting adopted some years ago by the American Gas Light Association.

I quote at length the explanation of two of the accounts as given in the classification book; these explanations are to be

studied carefully. The first is an operating account. The second is an asset account:

"B. 8—Street Mains Abandoned.

"This account is intended to show the original cost of old mains abandoned or replaced by mains of larger size, less credit for material recovered.

"NOTE.—In case of old mains replaced by mains of larger size, charge this account and credit 'Street Main Improvement' with original cost of old main when laid, less present value of material recovered and taken into storeroom. If original cost cannot be arrived at, use estimated cost based upon present cost of laying the same size pipe. (See Street Main Improvement Account.)

"In case of old main abandoned and left in the ground, charge this account and credit 'Extension of Mains' with original cost."

"NOTE.—At the end of fiscal year, close this account into 'Distribution.'"

"Street Mains Improvement.

"Under this general heading, accounts are to be opened which will show the cost of laying new street mains to replace old mains. Separate accounts are to be opened for each undertaking.

Labor and material in the following items:

Abandoning main when a new main is laid to take its place.
Cartage.
City permits.
Connecting mains so laid to old mains.
Lamping and watching.
Laying new mains, when they are laid to replace old mains.
Paving over any of above work.
Removing main when a new one is laid to take its place.
Repairing tools to be used on above work.
Salary of foreman on above work.
Taking measurements and records.
Tools issued for above work.

"NOTE.—Separate accounts can be designated by street: for example, 'Street Main, 6-inch, Market Street'; or by number.

"Credit this account and charge Storeroom Account with the present value of any material recovered and placed in storeroom.

"Credit this account and charge 'Street Mains Abandoned' with original cost of old main when laid, less value of material when recovered and

taken to storeroom. If original cost cannot be arrived at, use estimated cost based upon present cost of laying the same size pipe.

"Close balance of this account (representing increased cost of new main laid over cost of the original smaller main replaced) to 'Extension of Street Mains' at the end of the year. (See 'Street Mains Abandoned.')"

Referring to "B. 8.—Street Mains Abandoned."

Assume that a main of larger size is required in a certain street and the conditions are such that it will not pay to recover the old pipe. Then the new pipe will be charged to a plant account, in this case named "Extension of Mains."

As the laying of the new main of larger size causes the abandonment of the old main of smaller size, the addition to the debit of the plant account must be only that portion of the cost which represents the increase in size of main and the corresponding increase in service capacity. As the total cost of the new main has been debited to "Extension of Mains," it remains to credit that account with the original cost (as well as it can be ascertained) of the abandoned main. This is effected by the following journal entry:

	DR.	CR.
Street Mains Abandoned, Dr.,	$000.00	
To Extension of Mains,		$000.00

Original cost of —— feet of 4-inch cast-iron pipe abandoned on Washington Avenue between 3d Street and 10th Street. Replaced by a 12-inch pipe.

According to the directions given, the debit balance to "Street Mains Abandoned" will be closed into "Distribution" at the end of the fiscal year. This is done to get the cost of abandoned mains included as one of the year's items of distribution expense. Finally "Distribution" will be closed into Loss and Gain Account, by debiting the latter and crediting the former account.

We will now take the same case except that in replacing the smaller main with the larger main, the smaller main is recovered and stored ready for use in some other street where a smaller pipe will meet the requirements. Referring to Street Mains Improvement Account we find the instructions are to open a sepa-

rate account for each undertaking. This simply means that to keep advised more easily of the cost of each extension and to give greater opportunity to compare the actual cost with the estimated cost, a separate account shall be kept in each case, the balance of each separate account to be closed later into Street Mains Improvement General Account.

The journal entry for this would be:

	DR.	CR.
Street Mains Improvement General, Dr.,	$000.00	
To Street Mains Improvement No. 33,		$000.00

And then would follow the description.

We will disregard this step for the moment and refer in general to Street Main Improvement Account and have it understood that this is a plant account.

Reading the explanation of this account we find that the labor and material for laying the new main *and removing and recovering the old main* is charged through cash to this account.

Then this account is to be credited with the original cost of the old pipe as laid, plus the extra cost of recovering the pipe from the ground. The present value of the recovered pipe, as determined by market price and condition of pipe, is debited to Storeroom Account. (This account will be credited later when the pipe is taken from the custody of "Storeroom" for use in some other street.)

The amount credited to Street Mains Improvement Account, less the amount debited to "Storeroom," will be debited to "Street Mains Abandoned." At the end of the year, in closing the books, this last account will be closed into "Distribution" and "Distribution" will be closed into "Loss and Gain," as already explained.

Let (j) equal the original cost of the 4-inch pipe as laid.

(k) equal the cost of recovering this pipe.

(l) equal the present value of the recovered pipe.

Then (j)+(k) must be credited to Street Mains Improvement Account and there must be debited (j)+(k)—(l) to Street Mains Abandoned Account and (l) to Storeroom Account.

Then the first journal entry will be:

	DR.	CR.
Street Mains Abandoned Account, Dr.,	(j)+(k)—(l)	
Storeroom Account, Dr.,	(l)	
To Street Mains Improvement Account,		(j)+(k)

Crediting to "Street Mains Improvement" the original cost of —— feet of 4-inch cast-iron pipe recovered on Washington Avenue, between 3d Street and 10th Street, replaced by 12-inch pipe. Original cost plus cost of recovery (j)+(k), minus present value of pipe (l), charged to "Street Mains Abandoned," and present value of pipe at —— per foot (l), charged to "Storeroom."

(I have purposely written this entry in form somewhat different from that formerly employed. Here instead of writing "Sundry Accounts as below," followed by the accounts so referred to, I write in at once, above the account credited, the two accounts debited. I do this, in line with what I have done in other parts of my notes, to show that there are variations in good practice; those interested must be prepared to meet variations in methods, representing good and bad practice.)

After the succeeding closing entries are made, as before explained, the fixed asset account of "Street Mains Extensions" has been credited through "Street Mains Improvement" with the original cost of the 4-inch pipe; "Loss and Gain" for the year has been charged with that amount, less the present value of the pipe recovered; and the liquid asset account "Storeroom," has been charged with the value of the recovered pipe. So the net depreciation has been charged to "Loss and Gain" and credited to a division of Plant Account.

Another case, before referred to in another connection, can be employed to illustrate two of the points I have been trying to impress:

The conditions under which depreciation can be credited properly to Plant Account; and

The fact that certain parts of plant can be fully maintained by current expenditures, without recourse to an estimate on accruing depreciation.

I refer to the maintenance of the consumers' meters of a gas company,—and this is a typical case.

The practice followed by certain companies is to bring all the meters in to the repair shop in rotation. The work goes on continuously and at such a rate that the complete round of the whole system is made every five years. The meters are inspected, repaired, their working parts renewed, and the meters tested and resealed by official inspectors before being put into service again. The meters found to be in such bad condition as not to warrant repairs, are condemned and their cost is credited to Consumers' Meters Account; and the same course is taken with respect to all meters destroyed by fire or accident. All of this is in addition to the repairs and renewals made in answer to complaints.

New meters purchased to replace those condemned are debited to Consumers' Meters Account, a part of Plant Account. New meters purchased for extensions are, of course, charged to the same account.

By this system the meters as a whole are maintained at a uniform condition of efficiency and so no further charge for depreciation is necessary or allowable.

The journal entry required to account for the meters so condemned might be in the following form:

	DR.	CR.
Consumers' Meters Condemned, Dr.,	$000.00	
To Consumers' Meters,		$000.00

—— meters (specifying numbers of each size or referring to detailed record in some auxiliary book) condemned in course of inspection, repairs and renewal of working parts, for the (——months or year) ending this date.

"Consumers' Meters Condemned" would then be closed either direct into Loss and Gain Account, or, preferably, first into "General Repairs" or "Distribution Repairs," and so into "Loss and Gain."

The credit to "Consumers' Meters" being posted to that branch of Plant Account, would reduce its debit or asset balance to correspond to the inventory of meters.

A passing reference has been made to the practice of distributing by means of a suspense account a large item of depreciation loss over a period of years arbitrarily determined. This

method may also be employed in accounting for any large loss item which would be found too burdensome if charged against the income of any one year.

By way of illustration, assume that a portion of the steam plant has been destroyed by explosion, and that the cost of the plant so destroyed was $20,000. Assume that it is desired to spread this loss over five years, including the current year.

Then the proposition is to debit $4,000 to "Loss and Gain" (directly or through some operating account), and to debit $16,000 to a suspense account; crediting the $20,000 to Steam Plant Account, so reducing or writing down the balance to the debit of that asset account. Thus $4,000 is included in the expenses or losses of the current year and $16,000 is set up as a vanishing asset.

At the end of each of the succeeding four years Loss and Gain Account would be debited and the suspense account credited with $4,000, so distributing the loss over the five years; and at the end of the fourth year closing the suspense account by means of the successive debits.

The journal entries might be as follows:

	DR.	CR.
Loss and Gain Account, Dr.,	$ 4,000.00	
Steam Plant Suspense Account, Dr.,	16,000.00	
To Steam Plant Account,		$20,000.00

Crediting to Steam Plant Account the cost of that portion of steam plant destroyed by explosion June 4, 1911; charging up one fifth against this year's income and providing for distributing the remainder over the succeeding four years.

At the end of each of the next four years, in closing the books, the following journal entry would be in order:

	DR.	CR.
Loss and Gain Account, Dr.,	$4,000.00	
To Steam Plant Suspense Account,		$4,000.00

Charging as part of the year's expense one fifth of the cost of explosion of June 4, 1911, as distributed over five years. See Journal page —. (Referring to the previous entry.)

So at the end of the fourth year Steam Plant Account would be relieved finally of the cost of this portion of the plant and the cost would have been charged against the income of the five years. The cost of the new plant would be capitalized by being debited to Steam Plant Account.

A modification of this plan is to charge the cost of new steam plant to the capital account, "Steam Plant." After the work is completed this cost of restoration is distributed over the five years by credits to Steam Plant Account, and debits to Loss and Gain Account, so relieving Plant Account of the cost of rebuilding the plant and leaving Plant Account still charged with the cost of the original plant.

By the first method Steam Plant Account is relieved of the cost of the original plant, but charged with the cost of the new plant. By the second method Steam Plant Account is left finally charged with the cost of the original plant, and relieved of the cost of the new plant.

This method would be applicable where depreciation was covered by liberal charges each year to repairs and maintenance, including therein some charges for plant which strictly defined would be found to be for extensions or improvements. Here the accruing depreciation over and above current repairs and renewals would be covered by new plant added which would be taken as an offset to the accruing depreciation on other parts of plant.

If, however, a Depreciation Reserve Account and a Depreciation Sinking Fund Account were maintained to cover accruing depreciation, the problem would be quite different.

For instance, assume that the part of steam plant destroyed had been included in the expectation-of-life table on the basis of a twenty years' life, and, say, sixteen years of this life had expired at the time of the accident. Not until the end of four years more would there be available from the "Depreciation Sinking Fund," the cash to pay for the loss. In this case sixteen payments have been made into the sinking fund, and four more payments would remain to be paid. Assuming that the sinking fund rate of interest was 4 per cent, then the annual payment to cover this

part of the plant for a twenty-years' life would be 3.36 per cent of $20,000, or $672. Then the sum accumulated for the renewal of this part of plant at the end of sixteen years would be only $S=A\frac{r^n-1}{r-1}=672\frac{1.04^{16}-1}{1.04-1}=672\frac{1.873-1}{1.04-1}=\$14{,}666$, leaving a deficit of $20,000—$14,666=$5,334. To have accumulated the $20,000 in sixteen years would have required an annual payment to the sinking fund of 4.58 per cent of $20,000=$916, instead of $672.

Assuming that the plant is rebuilt and that the income of the year can support the unexpected burden of $5,334, the $14,666 could be withdrawn from the sinking fund, the deficit charged to "Loss and Gain," the $20,000 credited to Steam Plant Account, and the new steam plant as erected debited to Steam Plant Account through Cash Account. Thus the Plant Account would be written down $20,000 on account of the old plant, debited with the cost of the new plant, and so the account would represent the cost of the plant as renewed. The balance to the debit of "Depreciation Sinking Fund" would be reduced $14,666 and the balance to the credit of "Depreciation Reserve" would be reduced a like amount; and so the accounts would be readjusted to the new condition introduced by the accident. The book entries would be as follows: The cash received from the sinking fund, $14,666, would be entered on the debit side of cash-book and so be posted to the credit of Sinking-Fund Account, reducing the balance to the debit of that account accordingly.

Then would follow this journal entry:

	DR.	CR.
Depreciation Reserve Account, Dr.,	$14,666.00	
Loss and Gain Account, Dr.,	5,334.00	
To Steam Plant Account,		$20,000.00

Crediting to Steam Plant Account the cost of that portion of steam plant destroyed by explosion June 4, 1911; charging up the sixteen years' sinking fund accumulations, on basis of twenty years' life to Depreciation Reserve Account, and the balance to Loss and Gain Account for the current year.

Then as payments were made by Cash on the new plant they would be entered on the credit side of the cash-book and so posted to the debit side of Steam Plant Account.

If it were not deemed advisable to charge the whole of the $5,334 against the income of the one year, the burden could be spread over a number of years, say four, by first charging one fourth only to "Loss and Gain" and three fourths to "Suspense Account," as before explained.

ANALYSIS OF DATA

In this course of lectures on some of the business features of engineering practice, I wish to give brief attention at least to the vitally important subject of analysis of data.

In your professional work you will be called upon continually to refer to the records of experiences, investigations, and deductions of others. You will find it necessary to consult text-books, the transactions of technical societies, and other sources of information more or less reliable.

Then let me urge upon you with all possible emphasis this suggestion: Before accepting data, and especially so when some definite question is at issue, satisfy yourselves as to its reliability and completeness.

In collecting your evidence you will have to deal with conflicting, or apparently conflicting, statements. First you should determine whether the statements are conflicting; and if they are found to be so, there remains to be determined which shall be accepted and which rejected. This decision may involve great personal responsibility. The sources of the several statements should be investigated with care. Frequently this alone will furnish sufficient warrant for rejection or acceptance. If the conflicting statements emanate from individuals whose personalities are known to you, this knowledge of itself, in many cases, should enable you to decide. Sometimes a careful analysis will show that there is no real conflict, for the statements will be found not to cover exactly the same ground; and, therefore, adjustments must be made in advance of comparisons.

Incidentally in my previous lectures I have pointed out the danger of accepting partial or incomplete statements. I have told you of instances in my own experience where partial statements of two or more men, of acknowledged repute as experts in their line, had been so combined as to give an apparently complete endorsement to some process or device. In many of these cases my investigations have shown that these statements, which, when combined, appeared to offer a sufficient verification of the

claims advanced, had not been prepared as the result of coincident investigations, and, therefore, were defective for the building up of a complete record.

I think of an instance where two such incomplete statements were signed respectively by two professors attached to a college of engineering of the first rank. One certificate furnished a most satisfactory verification of the claims made as far as quantity of product was concerned, and the other furnished an equally satisfactory verification of the claims as to quality. In the prospectus the adroit promoter so combined these two statements as to make it appear that each was the complement of the other. These professors, if experts, should have known that the result claimed for the process—considering both quantity and quality—was impossible of accomplishment; and yet, they were each willing to give a certificate as to the isolated results as found without considering the claims in their absurd entirety. Later investigations made by me proved that if the claimed result as to quantity was obtained, then it was impossible to verify the claim as to quality; and if the claimed result as to quality was obtained, then it was impossible to verify the claim as to quantity. It was also disclosed that the apparatus was purposely designed to deceive. These two incomplete reports, so written as not to suggest that they were incomplete, were given to a conscienceless promoter who succeeded therewith in robbing hundreds of people of their small savings. I am sorry to say that I could cite a number of such cases from my professional experiences.

This all indicates that in the analysis of data we should be careful to cover by our investigations all the factors involved. Isolated statements or even isolated facts should not be accepted. Every statement should be read with its context, and, as honest and intelligent men, if we quote a statement of fact or opinion, we should quote it with the context, and *we ourselves should be careful to bear in mind the context.*

By way of further illustration let me refer to a matter which frequently occasions misunderstanding on the part of the uninitiated.

The amount of gas registered by the station meter at the works

is compared with the amount sold as determined by the records from the consumers' meters, and the difference is loosely described as "leakage." The fact is, that there are a number of other causes for unaccounted-for gas besides the physical leaking of the gas through the mains and services; such as, difference of temperatures of registration between the station meter and the consumers' meters; the condensing in the holders and distributing system of the vapors carried by the gas; incorrect estimating of the amount of unmetered gas supplied to street lamps; the impossibility of making the period covered by the registration by the station meter exactly correspond with the period covered by the reading of the consumers' meters.

Whether we call that portion of the gas manufactured but not sold "leakage" or "unaccounted-for" is somewhat an academic question, but there is another question involved in this matter of leakage which is decidedly practical. As a test of efficiency, we find comparisons frequently made of gas "leakage" on the basis of per cent of output. In one city the "leakage" may be 5 per cent of the total output, whereas, in another city, the "leakage" may be 10 per cent of the output, and yet the latter, even upon superficial investigation, may show greater efficiency of plant and management. This may be readily seen. Suppose we have two companies, A and B, with exactly the same mileage of mains and exactly the same per cent of "leakage." A is sending out twice as much gas as B; or, to be more definite, let us suppose that A is sending out 200,000,000 cubic feet per annum, whereas B is sending out only 100,000,000. Let us suppose, further, that the "leakage" in each case is 5 per cent of the output. Then the actual amount of gas lost or unaccounted for in the case of A is 10,000,000 cubic feet per annum, whereas the loss of B is only 5,000,000. So we find that with equal mileages of pipes, B's "unaccounted for" is only one half that of A, notwithstanding the fact that by the statement in the form of per cent the leakages are equal.

To show still more completely that the gas unaccounted for of several companies cannot be compared on the basis of per cent of output, assume there is a company which has just completed

its main system and turned the gas into its mains, but has not yet connected up the mains to any of its consumers' meters. In this case the total send-out would be "leakage" and hence would be 100 per cent; and this would be so no matter how well the mains might be laid.

Notwithstanding the facts here shown there are those in authority who make comparisons between companies as to unaccounted-for gas on the percentage basis. A certain company is found to have a "leakage" of 5 per cent of its output and the investigators are, therefore, satisfied that the mains are in fairly good condition and that the management in this respect is satisfactory. In another case the "leakage" is found to be 10 per cent and it is therefore assumed that the mains are in unsatisfactory condition. Notwithstanding these surface indications to the contrary it is quite possible that the plant showing the 10 per cent unaccounted-for may be in better physical condition than the plant showing the 5 per cent loss. The large per cent of unaccounted-for may, of course, indicate that the amount sold is less than it should be, and therefore the sales department may be at fault, but the efficiencies of the distributing department and the sales department are not to be confounded.

Having seen that comparisons by per cent should not be made in comparing the unaccounted-for of several companies, it is to be understood that such comparisons are correct and necessary when made between different periods of the same company. If for the year 1911 the per cent of unaccounted-for is more than it was for the year 1910, investigation as to the cause is in order.

The intelligent analysis of data is required when we are attempting to make comparisons between the efficiency of management of the several departments of a single concern. In connection with my talks on accounting, I have tried to impress upon you the fact that if we are to obtain the most economical management through the many steps included in operation, we must be able to determine through a systematic statement of items of cost exactly where there is room for improvement and where we may, at least for the present, be satisfied with the result obtained; so, in connection with our present subject, we

must be prepared through a careful consideration of all data available to determine as to the relative efficiency of the management of each of the several departments of any business in which we may be concerned.

I am reminded of something that happened some years ago. I shall not go into the details, but it is sufficient to say that in connection with the arguments made from time to time in favor of an improved form of retort furnace and setting, an engineer of the old school, in charge of one of the largest plants in the country, repeatedly stated that his "benches" of antiquated design, cost him much less money to install and were giving results equal in economy to the results claimed for this new and more expensive form. These works later came under my management and I then found that there was apparently a "leakage" of about 33 per cent of the output. Investigation proved that the mains were in better condition than any other part of the plant and that the superintendent of distribution was the most efficient official in the company's service. The explanation of the claim for efficiency of these antiquated retort settings and furnaces was suggested by the excessive "leakage" in connection with an efficient distribution system, and the discovery that the amount of gas manufactured was arrived at by estimate. There was not sufficient station meter capacity to register the total amount made at the time of maximum output, so from time to time, when the capacity of the works was not taxed, test runs were made, the gas being measured in a station meter of sufficient capacity for the amount of gas then made. *The total coal carbonized was credited with the rate of production established by these experiments.* Further investigation proved that these experimental or test runs were entirely unreliable as a basis of estimate. As soon as the gas was correctly measured, the statement of gas produced was materially reduced; and so the statement of the amount sent into the mains was reduced, and in turn the per cent of leakage was reduced. Thus it was discovered that the management of the works was much less efficient while the management of the distribution department was much more efficient than the records had indicated. Furthermore, it was

found that the claim made that the old-style furnaces and retort settings ("benches") were as efficient as the improved (regenerative) benches was entirely without warrant.

When we are called in as engineers to investigate any proposition as to the worth of a plant or a business, we at once have to depend upon our powers of analysis. A man who is not capable of analysing data fairly and intelligently is worthless as an investigator. I believe I am correct in saying that in a majority of the many cases I have investigated, where specific claims had been made as to quantity and quality of product, upon going to the works to investigate, it has been found that there were no means on the ground for completely measuring quality, or quantity, or both, and that the extraordinary results claimed had been derived from more or less elaborate systems of estimation in which the wish was father to the claim. For instance, I call to mind one case where the most extraordinary statements had been made as to the quantity of gas produced from a given quantity of coal. These statements had been widely accepted and many men of the highest standing in the business world had been induced to invest in the company controlling the process. Certificates had been furnished by engineers who were supposed to be capable and honest. When we undertook the investigation, we found that there was no station meter for measuring the quantity of gas produced, the measuring being done by noting the rise and fall of the gas holder, and this without correcting for change of temperature, which amounted sometimes to as much as 40° Fahr., and without due allowance for the fact that gas was going into and going out of the holder at the same time. Furthermore, it was found that the amount of coal used had been determined by the use of small platform scales and that there was no evidence that the coal, as supplied to the apparatus, had always been weighed. The records of ordinary laborers had been taken in this case. Another factor tending to vitiate the coal records was the fact that gas was made during two "shifts"—day and night—there being a strong rivalry between the foremen of the two shifts, each wishing to make the better record for coal and oil used. When we came to check up the coal pile by

the treasurer's books, we found that nearly twice as much coal had been used as had been included in the attractive statements of cost.

Again, in the case of gas process investigations we have to test the claims as to quality by accurate measurements of candle power and calorific value. I call to mind a case, and a most important one, where the gentleman whom I was assisting had come from Europe for the express purpose of investigating the claims made for a certain process. The investigation was carried on through a number of different works. At one of these, when we came to use the photometer to determine the candle power of the gas, we found that the sight box could be moved through a range of four candles without making any marked difference in the distinctness of the image on the disc; and, yet, this photometer was in charge of a man who had an established reputation for ability in laboratory observations.

I think of another instance where a certain engineer had been for years claiming that, by his method of scrubbing and condensing, the gas acquired or retained an additional illuminating value of two candles. Later these works came under my direction, and I found that the photometer *upon whose accuracy these claims for increased efficiency depended* was out of adjustment at a number of points; the candle balance was non-sensitive, and the Bunsen disc had been in use for about ten years and was so discolored as to have outlived its usefulness. As soon as the photometer was re-equipped and re-adjusted, we were unable to detect any increase in candle power due to this special method of scrubbing and condensing. Yet these claims had been accepted on the reputation of the inventor and considerable apparatus had been sold upon his unsupported statements.

In making our comparisons on the relative cost of product or on relative efficiency of plant, we must be careful not to magnify the importance of any one item at the expense of any other item, or, worse yet, at the expense of all the other items. While the case must be considered with regard to each of the individual items, we must also consider the case as a whole.

Again, I am reminded of an experience gained in connection

with an effort to eliminate an item of waste due to heat escaping with the products of combustion. We devised an addition to the apparatus which was intended to recover a large portion of this heat. At first the result was most encouraging and we were apparently making a satisfactory saving on each thousand feet of gas produced. At the end of six months, however, the repairs on this additional apparatus had increased until the cost for repairs was twice as much per thousand as the apparent saving.

In making our investigations we should be sure that the instruments used for our measurements are completely adjusted and standardized. For instance, in the case of gas investigations we should be certain that the means employed for measurement of volume are correct and that the photometer, which is used for the measurement of candle power, is accurate. We should, still further, be positive that *the gas we are measuring is the gas that is being produced.* I recall an instance where, after two weeks of hard work, the men engaged on the investigation found that the gas they had been measuring for candle power was taken from another pipe than the one they had supposed. In other words, the measurements for volume were correctly taken but the measurements for quality were made on gas produced by another apparatus.

I will give you another instance by quoting from a letter received not long ago from an eminent engineer:

> Recently we had occasion to make a fuel test and I found that the man in charge failed to test properly the scales before use.
>
> He was weighing wagons of approximately 1800 pounds each. The test he made of the scales was to stand a man in the center, get his weight, stand him at each corner and get his weight, and find that each time the weight of the man was shown to be the same as when he weighed on the standard scales. This was regarded as satisfactory evidence that the scales were correct. I believe that further it was determined that the scales worked freely—turning for a small additional weight, and that everything was clean about the pit.
>
> After the test had gone on for some time it was found that the scales were not weighing the same as another set of scales, and it was ascertained that the platform and its supports were not sufficiently rigid and had been bent under the 1800 pounds weight.

Particularly I wish to warn you against the blind acceptance of published data, and especially comparative tabulations issued by government authorities. These tables are the favorite ammunition of the "experts" trying to demonstrate a theory they have adopted in advance. When we consider that the material entering into these comparative tables usually has been collected from many sources, and that those who have furnished the material have been guided by varying instructions, or by *varying interpretations of the same instructions,* it is easy to understand why the figures in the same column cannot be accepted safely for comparison.

In some of my previous lectures I have incidentally shown that the avoidable and unavoidable variations in the interpretation of a uniform system of classification of accounts, lead to results which are not fairly comparable in the absence of individual explanations. I have also shown that certain "experts" have interpreted the tables issued by government authorities to develop testimony directly opposed to the facts. I particularly remind you of one case in which a certain professor developed a cost of thirteen cents per thousand feet of gas when the fact was that the cost as derived from a complete analysis of all the tables was forty-three cents and the chairman of the commission responsible for the tabulation endorsed my statement to that effect. The saddest part of this incident was that this "expert" persisted in and published his false statement after the correction had thus been officially endorsed.

In short, in all of our investigations we should be sure that the methods we are employing are giving correct and *complete statements* of fact and we should never accept any other person's say-so if there is any possible way of investigating for ourselves. When we do accept the statement of someone else, that fact should be shown. If we sign a report, it should be because we have personally verified all the statements contained therein, or we should qualify our statements, where necessary, by stating our authority.

Or to state it more briefly:

Be thorough.

Do not be led.

Keep your wits about you.

Use your common sense.

State what you know.

Show in detail (by addenda if preferable) the steps taken in your investigation and the bases for your deductions.

If your report is not complete, be very sure to state that fact, pointing out wherein it is incomplete.

NOTE.—I refer you particularly to the lecture by Mr. H. P. Gillette reprinted in Part III. Note particularly his remarks on percentages to be included to cover omissions, contingencies, and profits.

SPECIFICATIONS, ESTIMATES, CONTRACTS, AND APPRAISALS

Incomplete as is this collection of Lecture Notes, failing as it does to touch specificially upon some important business features of engineering practice, I feel that some definite reference to specifications, estimates, and contracts, and incidentally to appraisals, must be included.

In my talks I have frequently made incidental reference to this branch of our subject, and especially when describing and illustrating the use of the statistical and auxiliary books which, combined with the regular books of account, should provide a complete record of the transactions of an industrial concern.

First, we have to bear in mind that we must consider this subject from the standpoint of the buyer as well as that of the seller. Some of you as contracting engineers or manufacturers will have to submit to the stipulations contained in the specifications and contracts prepared for your guidance and control. Some of you after so contracting may sublet parts of your contract to others and so become interested in the preparation of such specifications and contracts as will in turn guide and control those whom you are bringing in to share your responsibilities. And some of you as purchasers of plant will have to control the seller.

Again, some of you as consulting engineers may have to occupy a more neutral position in representing the purchaser, or standing between the purchaser and the manufacturer or contractor.

So what I have to say should be capable of fair application by either party to a transaction in which is involved a specification, an estimate, and finally a contract.

In connection with any piece of work to be performed the first thing required, preliminary to a contract, is that the exact character of the work shall be fully and explicitly defined.

This calls for the preparation of exact and comprehensive specifications and engineering drawings. As to the drawings

I know that your technical training has been fully cared for in other of our departments; and yet, before passing on, let me emphasize as an important feature of engineering practice that all engineering drawings should be completely self-explanatory and should be checked up in every possible way before they are employed in connection with a specification accompanying a contract. Unfortunately, it is too common an occurrence to find that the several parts of a drawing or set of drawings do not support each other as to dimensions or features of design, or both.

For a piece of work of any importance, specifications should be prepared carefully and made to agree in every particular with the engineering drawings. It will be found frequently that the effort to bring about this agreement will indicate the necessity for modifying the drawings or the specifications, or both.

For the moment, I cannot think of any one detail included in this portion of the engineering field that is of such vital importance from both the technical and the commercial standpoints as this preparation of drawings and specifications, complete, comprehensive, and exact in all necessary details and in perfect harmony with each other.

In the case of work of any magnitude, only by such complete planning ahead can the best possible result be obtained from the minimum of capital expenditure. Here it is to be seen how the technical and commercial features of engineering practice are interwoven from the very beginning of any industrial undertaking.

Where a certain class of work is being repeated frequently, with comparatively minor modifications to meet local or special conditions, standard drawings and standard specifications should be developed. As soon as any difficulty appears in connection with any one undertaking from which we can gather experience for future application, the standard drawings and specifications should be modified; or, if a general modification is not deemed advisable, notes should be made for our guidance in any similar future case.

If in the same business a number of lines of work are followed,

as many sets of standard drawings and specifications should be prepared.

For each special line an estimate book should be developed in which there shall appear every item that experience has shown will be required.

This should be supplemented as often as experience shows us (which at first will be very often) that in our previous estimates some items were omitted.

The cost of each specific item must include the cost of placing the material and the men on the ground where the plant is to be erected, or there must be included as separate items the cost of transportation, including freight, carting, insurance, etc. In making up the items of an estimate we must be careful to see that there is no gap between the items which cover transportation and the items which cover erection. *Not infrequently, actual cost exceeds estimated cost because material has to be stored and rehandled after delivery and before erection or because wages have to be paid to men waiting for the opportunity to commence their work.*

A competently prepared and maintained estimate book is worth many times its weight in gold. The accumulated records and special data of such a book, modified and corrected to conform to the teachings of experience, is of the utmost value in the preparation of specifications and estimates for future undertakings.

After including every item that can be identified as a necessary part of the construction, there is another which should never be omitted—an adequate allowance for omissions and contingencies; for no matter how capable, careful, and conscientious we have been to include separately all construction items, there are sure to be some omissions and there are sure to be unforeseen contingencies. In every engineering undertaking in which variations are introduced through change of location or other of the limiting conditions, there will be required a change in our specifications. Furthermore we must include an item for contingencies and omissions because we cannot determine in advance the cost of the unavoidable chances which enter into the performance of every piece of engineering work of any importance. Some engineers

provide for this item by making a liberal estimate of cost on each important item. I prefer to place against each item what I believe will be its cost as exactly as I can estimate it on present market conditions and then add one item for omissions and contingencies, say in ordinary cases, as a minimum, 10 per cent of the total cost of all the specific items. Before deciding what per cent shall be included to cover omissions and contingencies the situation should be studied carefully, both in detail and in general, especially with regard to contingency chances. The fact is, that in many undertakings where certain broad assumptions had to be made as to controlling conditions, omissions and contingencies have absorbed the allowance therefor and the estimated profit, and then left a deficit. Generally these excessive expenditures do not add to the service value of the completed plant, though they do add to its cost and the necessary capitalization.

Even if we exercise all possible care, intelligence, and trained judgment to include, and provide adequately for, all specific items of cost, this item of omissions and contingencies cannot be omitted safely; and in certain special cases it must provide for elements so uncertain in their character that a considerable risk must be taken or a large amount must be included to ensure safety. If the estimate is prepared as the basis for a competitive bid on contract work, such a necessarily large item for omissions and contingencies may be a handicap in our efforts to secure the contract; for one or more of the other bidders may, either through incompetency, recklessness, or dishonesty, neglect to include any or a sufficient allowance for this item. In case of close competition, some dishonest contractors will deliberately omit this item, intending, if the cost goes against them, to escape by one means or another from the full force of the contract.

In such cases, the honest and prudent contractor should not allow himself to be influenced by fears as to what his competitor may be willing to do.

In addition to omissions and contingencies there are other items which should be included in the final estimate. If the estimate is being made by the contractor, then before he can calculate on any net profit, which ought to be not less than 10 per cent, he must

allow for the omissions and contingencies as before explained, and he must also allow for certain items of cost which are variously grouped under the head of "Overhead Charges," "Administrative Expense," "Undistributed Expense," etc. It needs no argument to show that in addition to the cost of material and labor, there will be the cost of salaries to engineers and assistants, including draughtsmen, timekeepers, inspectors, etc. Then there will be the pro rata of salaries of the officers and other employees whose time is devoted to the business as a whole, and also the other expenses of the general organization. Even in a concern engaged in the contracting business in a large way, this undistributed expense will amout to 10 to 15 per cent of the total distributed expense. Not infrequently I have known it to run as high as 25 per cent and occasionally as high as 50 per cent.

This is parallel to the case of "Shop Cost" and total cost, involving a difference sometimes much underestimated, and so leading to financial disaster. Before a net profit can be found for the manufacturer, in addition to shop cost, there must be included the cost of selling and delivering the goods; the pro rata of all general salaries and other administrative expense; the loss from uncollectible accounts; and depreciation of manufactured stock, assuming that depreciation of plant and raw material has gone into "Shop Cost."

In the same way, in a contract business, each contract must bear its share of the general expenses, and the engineer must include these in his estimate unless it is understood by those higher in authority that all items of cost beyond the actual construction will be added by the general management.

Assuming now that the estimate under consideration is made by the company which employs the contractor, it by no means follows that because the contractor has included his administrative charges that there will be no occasion for the former to include charges of a like character. Before the contract can be let plans and estimates must be prepared, and after the contract is let there will be need of engineering direction and supervision.

Also, if the undertaking is a new one, before the engineer's plan has been considered in detail, there will probably have been

the expenses incurred by a preliminary organization. Whether included by the engineer or by the general management, there are many items of cost which must be considered. One item stands out prominently—interest during construction. *All* the money spent prior to the time when the plant can earn a return on the investment is entitled to a return. For instance, assume that the cost is covered wholly by bonds; as the bonds are sold to pay for the plant, interest begins to run and so becomes part of the cost of plant. This is easily understood when we consider the case of a modern office building which even under the present extraordinary conditions of rapid construction will take a year or more to build. After the building is completed the rent roll yet has to be built up. Even if only a year is required, and assuming that the payments are made uniformly throughout the year, there will be a charge of one half year's interest on the total cost of construction. The chances are that on the land the interest charge will extend over a considerably longer period.

In the case of an industrial plant the land must be purchased early in the undertaking. Interest and taxes will commence to run from the day title is taken, and both of these items will increase as the work progresses. Again, the land probably will have to be prepared for the plant to be erected thereon. It may be that wharves, railroad sidings, sewers, grading, and roads will have to be paid for. The money spent for all preparatory work, whether physical or otherwise, is just as real as the money which is spent for brick, steel, and labor, and all of it draws interest.

Unfortunately, it too often happens that in promoting a new undertaking the prospective profits are calculated on the engineer's estimate which omits many of these items; some of which he is directly responsible for, such as omissions, contingencies, engineering, supervision, etc.; interest, which he is not directly responsible for as it falls under the head of financing, but the measure of which he is best able to calculate, depending as it does upon inventory cost and time to be consumed in constructing; and items which the engineer may be in no way responsible for, such as preliminary organization, legal expenses, administrative salaries, etc. It would be far better for the engineer, as

placing him in a position of greater responsibility, if he either included all of these items in his estimate, or at least drew attention to them. If he is called upon to make an estimate of prospective profits, he should either procure a statement from the general management of the amount to be included for all items outside of his department, or he should state distinctly that his estimate is to be supplemented by the inclusion of these items.

The failure due to division of responsibility to so cover the total cost of establishing an undertaking ready to earn on the total investment has been the cause of many schemes failing to make good the claims of their promoters.

Without here attempting to specify the amounts or percentages to be included for each of the items,—for these must depend upon the conditions as found—I give by way of warning and reminder the items which are too liable to be omitted by the inexperienced and the careless:

Omissions from design and specifications.

Incidentals and petty expense items.

Contingencies in connection with design and construction, including erecting parts out of sequence due to inability to control deliveries, strikes, weather, etc.

Other losses caused by strikes.

Insurance against casualty—employees and public.

Hazard of extraordinary casualty not covered by insurance.

Legal and other organization expense.

Engineering—including design and specifications.

Superintendence—including supervision and inspection.

Interest on all expenditures—say for one half of time covered by construction, making extra allowance for real estate if necessary.

Taxes.

Assuming that these are added to the estimate of the company employing the contractor, the contractor's "Overhead Charges" and profit must still be covered and should appear in the contractor's contract price. If he works on a percentage basis they will appear in his statement of cost.

Beyond all these items there are two of very substantial proportions yet to be considered, which have to do with the financing of the undertaking:

First, is the cost of getting the capital. If the cost of plant is covered wholly or in part by bonds, a discount must be allowed to the buyer. The rate of discount depends largely upon the rate of interest. Bonds on a new enterprise are seldom sold at par; a discount of 15 per cent, going partly to the bankers and partly to the investors, is not excessive.

Then there is the working capital, for which there may be required an amount equal to a considerable per cent of the fixed capital, depending upon the nature of the business. In some manufacturing businesses, the product being varied in character, and calling for the carrying in stock of large quantities of raw material and manufactures, the working or liquid capital required may be 10 per cent and even more of the fixed capital. If the working capital is not sufficient, and the concern carries a large floating debt, there will be the interest on loans to pay and the charge against the earnings will be increased by inability to take full advantage of trade discounts.

Then for these two items alone there may be required 25 per cent of the total cost of plant and organization. For the "Overhead Charges" previously described there may be required 25 per cent of the direct cost of the inventoried plant. Thus it is seen that to the engineer's estimate, if based only upon the items of material and labor scheduled in the estimate, it may be necessary to add 50 per cent in estimating the total investment; and even this allowance may be exceeded easily.

We may now turn to a brief consideration of matters connected with the work of construction as it progresses.

From the estimate book such as I have outlined, another book can be developed which may be employed to the greatest advantage in the actual performance of the work. This may be designated as the Contract Record. As work under a contract progresses, especially if the work is being executed at a point far removed from the home office, it is of vital importance that those

who are responsible at the home office for keeping the resident engineers supplied with the necessary material and men, should constantly have before them a record, complete to date, of the ordering and forwarding of material and men and of their arrival or non-arrival on the ground. This book should have columns so prepared that against each item can be recorded all the various steps taken between the ordering of the material and the completion of the work. It is therefore important that spaces should be provided for necessary notes in regard to working drawings, and modifications and additions thereto, the necessity for which may develop as the work progresses.

The resident engineer should be notified of all drawings, material, and men forwarded, *and he should be required to acknowledge promptly their receipt.* All these steps should be noted in the Contract Record. The notifying of the resident engineer may well be done through carbon copy books, so that we may be sure that the original sent to him is an exact duplicate of the carbon copy retained in the home office. These carbon copy books may be used conveniently for illustrating by sketches the minor details required to modify or further explain features of construction on which questions have arisen during the progress of the work and which have been referred to the home office for further explanation or decision. Where the change involves the seller of material or manufacturer of parts, the same sketches in triplicate should be employed. The orders for material should also be made out on carbon copy books so that one copy may be sent to the concern from which the material is ordered, one copy to the resident engineer in charge of the erection, and the third retained in the home office.

As I have said, every one of these steps, *as they are taken,* should be noted in the Contract Record according to a prearranged system. The final vertical column in this record should show the total cost of each item, there being sufficient other columns to show the details of each of these items.

When the contract is completed, the cost, as shown by the Contract Record, should be checked up with the treasurer's books to determine whether the cost, as shown in this book which is to

guide in the making of future estimates, exactly corresponds as to total cost with the figures shown in the regular books of account. To the inexperienced student it may seem strange that I take the time to make this point; but this is vital in the operation of such a scheme as I have now barely outlined. It is true, unfortunately, that here and in many other directions, the statistical and auxiliary books of an industrial concern are not always made to balance with the regular books of account. Often these two classes of books are kept in different departments—the regular books of account in the Commercial Department and the auxiliary books in the Engineering or Construction Department. And, not infrequently, sufficient friction or jealousy exists between these two departments to prevent that loyal coöperation so absolutely necessary for the securing of the best results. The man, then, who is responsible for the business as a whole should see to it that this coöperation is developed and constantly maintained. But if the manager is a technically trained engineer who regards bookkeeping as something below his dignity as a professional man, he will not be ready in the first place to call for such co-operation nor, in the second place, will he be competent to ensure it by proper supervision and direction.

After the Contract Record cost has been found or made to correspond with the treasurer's cost, the former should be compared item by item with the estimated cost. This comparison, if made carefully and intelligently, will assist greatly in developing accuracy in estimating, and incidentally will demonstrate the necessity for including the items for omissions and contingencies and overhead charges.

Now let us go back to the more specific consideration of the preparation of the specifications.

From what has been said it can be seen that an Estimate Book and a Contract Record (possibly combined) such as I have outlined can be employed most usefully in the preparation of specifications, provided the concern which employs these books is responsible for the preparation of the specifications. Such is not always the case, but often it is so.

The consulting engineer should so record all the data collected

in the course of his supervisory duties and should be keen and diligent to check his theories by the practice of those executing the work. Particularly the contractor will find these records necessary as a guide in bidding on work. Furthermore, as he will frequently be called upon to prepare the final detailed specifications and drawings to be attached to the contract, the keeping of these records most systematically becomes a matter of the greatest moment.

If bids are to be called for by a concern which is not informed in detail as to what should be required under the proposed contract, the probabilities are that a consulting engineer will be called in to advise and direct; or the work will be put at once in the hands of some contracting specialist who, by his integrity, common sense, and professional ability, has earned for himself the kind of reputation which the broad-minded business man recognizes as the best guaranty of a final satisfactory result.

Suppose now an estimate has been prepared as the basis for a bid, this bid to be accompanied by a specification in more or less detail according to the immediate requirements. The details as given in the estimate book may be self-explanatory to those in charge; but now the question comes up, Will everything be perfectly plain to the other party to the proposed contract? Will it be made plain what the contract does not include as well as what it does include? Not only must each item of the specification be so described that the meaning is perfectly clear to us, but we must be satisfied that we have done our utmost to convey exactly the same meaning to the other party of the proposed contract.

This again brings to our particular attention a point which I impress upon you so frequently—that a sound working knowledge of the mother tongue is a necessity to the engineer, as it is to all who occupy or expect to occupy positions of authority. Why it should be necessary to impress this truth with such insistence upon engineering students, I have never been able to understand.

While it is desirable that the specification shall be concise, it is far more desirable that it shall be expressed in language admitting of only one meaning, no matter how inelegant that language

may be. We should not hesitate to repeat certain words if we are convinced that our meaning can be thus more certainly conveyed. If an apparently plain and simple statement is made before an audience, hardly any two of the listeners will have conveyed to their minds by the spoken words exactly the same impression. This fact should influence us constantly to exercise watchfulness and care even in the preparation of our less formal business communications. It should also be borne in mind that the written communication depends upon the cold words alone; there are no helpful gestures, expressions of the face, inflections of the voice to supplement and correct the imperfect speech; and also that the written communication possesses a property which may work to our disadvantage as well as our advantage—its permanence.

As has been pointed out in the lectures on commercial law, much of our correspondence is to be classed as the groundwork for contracts of one kind and another, and carelessness in expression may, to our surprise and dismay, lead us into annoying and expensive lawsuits.

I have also shown you from my own experiences how the haste which leads us to write communications that are not completely self-explanatory in the first instance entails upon the sender and the receiver the expenditure of time and nerve energy many times greater than that which would have sufficed in the beginning to have made the initial communication complete and self-explanatory. You will remember that I gave one instance where I arranged for the exhaustive analysis of all of one class of correspondence between the office of a parent company and its fifty or more branch offices, extending over a period of six months. While I knew that this investigation would disclose unsatisfactory conditions, the result was a surprise to me as well as to all others concerned. It was found that the number of letters written to explain and correct six monthly reports, which would have been unnecessary had the initial communications been correct and complete in every detail, ranged in each case from ten to one hundred and two.

Bear in mind that many of these men, whose correspondence

records were so analysed, were graduates of colleges of engineering.

Perhaps the greatest obstacle in the way of learning this lesson is that which obstructs all educational effort—the difficulty of making the student see the importance of the thing to be learned.

For the warning of those of you who are inclined to slight what some ignorantly and foolishly classify as little things, and for the encouragement of those of you who are thorough and conscientious in details, let me point out that in the business world where such inability and indifference or lack of conscientiousness are continually made apparent in unsatisfactory results, that the overworked, harassed manager of to-day turns with open arms to the—I am sorry to say—exceptional employee who lightens his pressing burdens by *completely* performing the tasks assigned to him. The young man who slights a task because he considers it too insignificant to engage the attention of one so talented and highly trained, deserves all the hard knocks which the world is so prompt to inflict upon the undeserving. Young men often complain to me because, as they say, there are not the same opportunities to make their way as there used to be. In my opinion there never have been greater opportunities than at present, and there always will be opportunities for the capable, thorough and conscientious man, any time this side of the millennium, and that is about as far as we need to look.

Having said all this by way of warning, it remains to be said that notwithstanding all the care, intelligence and specialized training which may be exercised in the preparation of specifications it is still impossible to avoid all misunderstandings and disputes.

Apart from differences of interpretation of words meant by the engineer to express a definite thought or intention on his part, cases must arise where it becomes necessary, or is considered advisable, to modify the original plans by reason of facts which first come to light after the work has been begun.

The items for extras are a fruitful cause for dispute in connection with the settlement of contracts. Unfortunately, some contractors endeavor to provide a place in their contracts for the

later introduction of extras, hoping thereby to get pay at higher rates for part of the work and at the same time lead the other party on to the making of a contract by holding out in the first instance the bait of a low lump-sum contract price. Conscientious engineers and contractors should exercise every possible precaution to reduce to a minimum the opportunities for "extras."

When it becomes apparent that such extra charges will have to be made, or when it becomes apparent that modifications of the specifications are required, steps should be taken at once to arrange a supplementary agreement between the two parties to the contract, rather than to leave the involved questions open as the probable cause for dispute or possible litigation at the time of final settlement.

The several clauses of a carefully prepared specification and tender may be divided into two classes:

General Clauses, which define the general conditions involved in the contract, the relative responsibilities of the several parties to the agreement, the lines to be followed in regard to acceptance on the part of the buyer, terms of payment, and the like; and

Specific Clauses, which cover the details of design and construction.

It is well to classify carefully in this way the several items of the specifications, bearing in mind that, if an agreement is reached, the specification is to become the very essence of the contract.

As a rule, the general clauses can be made standard, to apply with little or no alteration to all contracts of a certain class. This portion of the specification form should therefore be amended carefully as experience suggests. The original form and *all changes* should be submitted to the judgment of a competent legal adviser.

It is well here to remind you that whenever a doubt is suggested as to the best form in which to prepare a business paper so as to secure the maximum of protection under the law, go to a competent lawyer. And remember that a lawyer is not necessarily competent because he has been admitted to the bar. There

are misfits in this profession as in every other. You are ready to believe that it is wise for those not specifically trained in engineering science to consult a specialist as questions in that line arise; you, then, should be prompt to recognize the wisdom of engineers consulting specialists in the law when the particular question to be solved is one of the law.

I shall not here attempt to set before you specimens of specifications as actually employed in the field of engineering. Such examples would necessarily vary greatly with every branch of engineering considered. It would be only in general that such examples could be employed to advantage in such a crowded course as ours at "Stevens," especially as we find by our alumni directory that our graduates by no means confine themselves to the one branch of enginering which, for want of a better name, is styled Mechanical Engineering, but are to be found occupying positions of importance in every branch of engineering practice.

I would strongly advise you, however, as you settle down to practice in any one branch of our profession, to make a persistent effort to collect representative specifications from engineers of good repute. These men will frequently be found willing to furnish such specification forms in individual cases where they might be unwilling to furnish them for inclusion in these notes, which are intended for somewhat extended distribution.

Even the forms employed by the most eminent men in the profession should not be accepted blindly as applicable to a particular case in hand.

Before closing, a few words may be said on the subject of appraisals of properties.

The subject is of such commanding importance to-day in connection with the control of Public Utilities by government authorities that to its specific consideration might well be devoted much time and study; but the total time allotted to these lectures is about exhausted.

Incidentally in these lectures the subject has been considered and some of the most important elements involved have been considered in considerable detail. Much that has been given under the heads of Accountancy and Depreciation are directly

applicable. Practically all that has been said on Estimates has a direct bearing upon Appraisals.

It has been shown that the cost of a plant is by no means covered by the cost of the scheduled items of material and labor. Certain appraisers assume that because they can schedule the plant presented to their inspection, no allowance should be made for items outside and beyond that schedule. They argue that there are no omissions to be allowed for because all the plant is scheduled. This is not true, for it is rarely if ever that an inventory made as the basis of an appraisal does not omit items. But beyond this there are items which have cost money and which properly should be included and which do not appear and cannot appear in an inventory of the plant as it exists. Years after completion, the finished plant utterly fails to reveal to the sight of the appraiser many items of cost which had to be met, and which were beyond the control of those in charge. Also there were items of loss due to mistakes and accidents which are necessarily a part of all human undertakings, no matter by whom directed.

If twenty years from now the Hudson tunnel shall be appraised, who shall be able by an inspection of the physical assets to determine what was the cost of restoring the pipes, sewers, etc., underground, and of maintaining in condition for operation the elevated railroad, and the restoring of the surface of the streets? Or who shall be able twenty years from now by inspection of the New York Central Terminal, now in course of construction, to determine what was the extra cost of keeping the road in operation during construction; what was the cost of the buildings and plant erected for temporary use; what was the cost of the temporary interference with other properties; and the like?

Nothing can be farther from the truth than the statement that a true appraisal of reproduction cost can be based upon the cost of the property as found and scheduled, even if the schedule is complete, which it never is. *Particularly must adequate allowance be made for the "Overhead Charges" enumerated in connection with the discussion of estimates.*

Let me warn you that the making of an appraisal is a service not to be lightly undertaken. Especially is there a tremendous responsibility assumed by those who undertake to appraise the properties of Public Utilities for rate making purposes, though this responsibility apparently is not recognized by many who assume to be experts in this line. Every class of Public Utility has its own peculiar problems and a just appraisal cannot be made by a man who is unacquainted with and incapable of solving these problems.

I have not so far prepared anything specific with reference to that important business feature of engineering practice; namely, the necessity for practicing within the limits set by commercial conditions. The time allotted to these lectures is already exhausted, and there are four reasons why I am satisfied that the subject has been sufficiently covered:

1. Mr. W. M. McFarland's article, reprinted from *Cassier's Magazine,* and included in Part I, should be sufficient, unsupported by further words on my part, to convince intelligent engineer-students that the condition named is one with which they must be prompt to comply.

2. This truth is almost invariably brought out prominently in the special lectures delivered by outside practitioners, and so naturally that frequently the lecturers themselves are unconscious of having emphasized this point.

3. I am continually including illustrations of this truth in connection with my talks on the other business features of engineering practice.

4. It should not be difficult for a student possessed of sufficient intelligence to meet successfully the test of three years of our "weeding out" process to appreciate that an engineering design or an industrial undertaking must necessarily be along lines which will afford an adequate return to the investor; that, therefore, the description of the engineering project must be such as to appeal to the banker who acts as the intermediary between those responsible for industrial undertakings and the general investing public; and that the honest and capable engineer must be prepared to discriminate between immediate and final profit.

My experience with nine senior classes is in accord with this theory. I have found the students more ready to acknowledge that commercial conditions control and limit engineering practice than they are to undertake the drudgery of preparing themselves to meet this condition intelligently and efficiently by familiarizing themselves with commercial limitations and business methods.

Now let me summarize my talks on some of the business features of engineering practice, as follows: Use your common sense as cultivated and developed by your "Stevens" training in theory; be keen to learn from those who have been trained in the school of experience; while relying upon your reasoning powers rather than your memory, make use of all relevant data which you know to be completely trustworthy; recognizing that the engineer is a commercial scientist, never forget that the money you spend for others is a trust.

And finally, be true to yourselves and so be true to your profession and your Alma Mater.

PART III

SPECIAL LECTURES

NOTES ON CONTRACTS

By

Howard E. White

Law is concerned with the exposition and application of those principles which regulate the relations of man to man. Criminal law prescribes and enforces the duties which man owes to the State and to the public as a whole.

Civil law deals with the private relations of individuals between themselves, and finds its chief end in preventing the occurrence of differences in the manifold activities of civilized life, or of adjusting such differences as shall have arisen. Law, in its broadest sense, is based upon a very few elementary principles of justice, fairness, and equity, which may be as well and easily understood by the layman as the lawyer. The technical niceties and refinements of the law have to do with the application of these principles to concrete cases, and require a lifetime of unremitting research and study. They are the special province of the lawyer.

No layman, however talented, is qualified to master these legal intricacies, but no one, however small his business, can fail of benefit from a consideration of general legal principles. The more widely they are understood and heeded in carrying on the everyday affairs of life, the less chance there will be of entanglement in tedious and expensive litigation, which may, whatever its outcome, ultimately ruin the most prosperous business or cloud the success of the most talented individual.

It is a matter of common experience to see men, eminent in their own specialties, so ignorant of business and its methods as to fail of success when they attempt to practically apply their knowledge and talents.

The object of these notes is not to attempt to impart knowledge which will enable a layman to become his own lawyer, but rather to instill a knowledge of the legal necessities of business

life, and to make possible the formation of a correct judgment as to when legal aid should be retained.

Money wisely spent for competent legal assistance, when large projects are in their inception, is likely to save the expenditure of a much larger sum in an attempt to correct the disastrous result of a careless or improvident act.

The Law of Contracts Important to Business Men.

A generally accepted classification divides the body of legal principle into two parts:

1. Those which concern torts.

A tort is the violation of some legal duty owed by one individual to another and existing independently of any contract.

2. Those which relate to contracts.

While some lawyers make a specialty of the former class, in which are comprised suits to recover damages for personal injuries, by far the larger number of attorneys are concerned almost exclusively with the second branch of the law.

Varied as the activities of modern civilization have become, it still remains true that, broadly speaking, the life of the average business or professional man is for the most part concerned with making and performing contracts. In the last analysis almost every action of the day brings us within the reach of some contract, express or implied.

Some knowledge of contract law, therefore, is a fundamental necessity to everyone.

What Is a Contract?

This seems a simple question and one to which almost every layman feels competent to respond. An attempt to do so, however, shows how difficult it really is to frame a definition sufficiently broad to cover the multitudinous varieties of contracts which are legally possible.

Almost as many definitions have been given as there are contracts. A sufficiently simple and non-technical one is as follows: *An agreement, enforceable at law, creating an obligation not*

theretofore existing, upon the parties or some of them, to do or refrain from doing some lawful act, in return for value received.

The most important feature of a contract is, of course, that it is the basis of some *new* agreement. It is creative, and by it the parties voluntarily assume obligations from which they were formerly free. The importance of a contract, from the standpoint of law, arises from the fact that, whereas it is created by the voluntary act of the parties, once made, it will be enforced by the courts, as strictly as though its terms were part of the statute law of the State. The very freedom given by the law in respect of contracts imposes upon the contracting parties the necessity for an added measure of caution. The courts extend no protection to the maker of an improvided contract. When it has once been signed the obligations imposed by it are as binding as though its terms were of the most advantageous character. The law supposes that in making contracts the parties themselves are best qualified to fix its terms, and, though these may at a subsequent date prove oppressive, the law will extend its utmost aid to their enforcement. The inviolability of contract rights is most jealously guarded by the law. The courts are called upon to consider more cases arising out of contracts, than from any other source. Out of the infinite variety of private agreements entered into arise an infinite number of variations in the application of established principles. To cope successfully with the niceties of interpretation the lawyer must be possessed of acumen, perseverance and genius. This is the technical side of law.

Executed and Executory Contracts.

Contracts are divided as respects the time of performance into two major classes.

1. Executed.
2. Executory.

In the first class are included those contracts which are performed, substantially at the time when they are made, or so shortly after as to make the whole transaction simultaneous, as in the case of a purchase of merchandise followed by immediate delivery. The agreement as to price constitutes a contract,

which is immediately executed or performed as the buyer departs bearing his purchase.

An *executory* contract is one in which a substantial lapse of time occurs between the making of a contract and the carrying out of its terms.

It is to the *executory* contract that we usually refer when we popularly speak of a contract, and it is with that branch of contract law that the present notes are concerned.

A large number of the contracts entered into are performed without differences between the parties. But it is certain that no contract should be made in any spirit of fancied security arising from this fact. The best of friends and the closest business associates are prone to disagree, and the better the friendship and the closer the association, the severer the breach. Every contract, therefore, which involves future performance should be regarded with respect to its ability to stand the test of such a disagreement and its consequent construction by the courts. It is obvious that the more distant the time of full performance the more chance there is for misunderstanding and difference.

Express and Implied Contracts.

It is important to remember that not all contracts are reduced to writing, or even orally phrased. It sometimes happens that a man by his acts, perhaps unintentionally, involves himself in certain obligations which he little suspects. This fact gives rise to another subdivision of executory contracts into—

1. Implied Contracts.
2. Express Contracts.

1. An implied contract is a relationship, which springs unbidden from the surrounding circumstances. Certain civil acts a man cannot commit unless he would accept the consequences. Thus, if a merchant delivers goods to a prospective customer, without order, and the recipient retains and makes use of such goods, the law implies a promise or contract to pay for them. Possibly the customer was ignorant of the law, and never intended to pay for what he used, but he may be forced to do so.

This is the simplest example of an implied contract, but it often happens that very complex problems are presented when the question arises as to whether an individual has not made himself liable to certain obligations by a course of dealings which he never intended should have such a result.

An implied contract is a pitfall to the unwary, and is referred to here by way of warning. Luckily there is a plain danger sign posted at its margin, obedience to which will prevent danger. It lies in the business maxim: *"Do not expect to get something for nothing."*

It may sometimes happen that this law may be violated and the offender escape scot-free, but its disregard always raises the danger that having received benefits under the impression that they need never be paid for, the law will step in and insist upon a just compensation.

It is always safest to ask, when in receipt of obvious benefits: What do I give in return? Not only is this true in respect to financial matters, but as well in matters of favor. One who grants a favor will some day expect one, and generally two, in return.

2. Opposed to the implied agreement is the express contract, with which we shall chiefly deal.

An Express Contract is one, as its name implies, which is framed either orally or in writing, with the intent by the parties to enter into a valid, binding agreement.

Examples are so common as to need no especial mention.

Written and Oral Contracts.

Except in instances especially covered by statutory enactment, a verbal or oral contract is exactly as binding as one in writing, if its terms be sufficiently proved. The attempt to do so is often involved in insurmountable difficulty. For this reason, if for no other, the question of oral contracts may be briefly dismissed with the statement that *they should never be entered into if they can possibly be avoided.* They are always dangerous and give rise to more litigation and discussion than can well be measured.

Insist that every agreement made should be reduced to writ-

ing, if only in the form of a memorandum. In this way only can trouble be avoided.

Statute of Frauds.

Some contracts must by statute be in writing in order to be valid. Thus, in every jurisdiction will be found statutes known as the Statutes of Fraud, which are practically uniform everywhere, and are to the effect that all contracts for the sale of property in excess of a specified amount in value; contracts which are not to be performed within a limited time, and contracts to become responsible for the actions of another person, must be in writing and signed by the person to be charged. The reason for such a statute is obvious.

Before passing to a consideration of the essentials of a contract, a word is proper as to the expression of its terms.

Many words do not mean a good contract. Still less does an excess of legal terms or phraseology. The best contract is the simplest both in form and language. As in every other written instrument, brevity should be sought, though not at the expense of clearness of expression. If, therefore, a contract is presented for signature, the meaning of which is not absolutely clear, signature to it should be refused. The word of an associate, or even of an attorney, that a certain unintelligible phrase has a definite meaning, is insufficient. If it be found that there is room for a discussion as to the meaning of a word, it should be remodeled at all hazards until there can be no two opinions as to the intent. The habit of careless expression leads to more ambiguity in contracts than any other one cause, and it is absolutely without excuse. The layman falls into the error through carelessness or inadvertence. At times the lawyer is equally negligent, but it also frequently happens that a lawyer attempts to draw a document so artistic in its brevity and conciseness that he sacrifices, more or less completely, clearness and common sense. But on the other hand, one should not be misled into thinking that the best lawyer is one who draws the most elaborate or impressive contract. The reverse is apt to be the case. When one receives from an attorney a contract which appears to be so simple that it seems that it

might well have been drawn without legal assistance, it is certain competent counsel has been retained.

The foregoing statements have been, for the most part, explanatory and analytical. We now pass to the essentials of a contract, written or oral.

ESSENTIALS OF A CONTRACT.

1. Parties capable of contracting.
2. A lawful subject-matter.
3. A definite, clear offer.
4. An unequivocal acceptance.
5. Complete agreement of parties.
6. Valid consideration.

1. Parties capable of contracting.

Every person who has attained legal age; who is under no civil or mental disability, temporary or permanent, and is free from compulsion, is capable of entering into a valid, binding contract.

In explanation of the foregoing the following should be noted:

Person.—The word person includes corporations and women. Corporations, however, must act within the scope of their charter powers. At common law married women were deemed incapable of contracting, but by statute in practically every jurisdiction this disability has been removed, and they may contract with entire freedom.

Legal Age.—By practically universal enactment the period of infancy terminates, for both man and woman, at twenty-one years. In some few jurisdictions women are deemed of age at eighteen. Local statutes should be consulted upon the point.

A contract made by an infant is not absolutely void, but may be avoided by the infant, who cannot, against his will, be forced to perform it. There are only two exceptions to this rule: One is that an infant may be compelled to pay for necessities furnished for maintenance or support. The other is that infancy is not a ground for breaking the marriage contract. It must be remembered, however, that if the infant be willing to abide by the terms of the contract he can enforce performance from the other

party thereto. In other words the defense of infancy is only available to the infant himself. A contract made with an infant during his minority may, however, ripen into a valid and binding contract when the infant becomes of age, provided, either expressly or by implication from his actions, he ratifies it after that time. Thus, if an infant makes a contract, and after becoming of age accepts benefits under it, it will make the contract a good one. The infant is under obligations if he wish to disaffirm his contract to do so within a reasonable time after he becomes of age. If he fail to take such action it is an implied ratification of his prior contract.

If the infant elects to rescind his contract he must, *so far as possible,* return all benefits which he has received thereunder. Should he fail to do so, he cannot escape liability upon his agreement. The general view, however, is that the infant is not precluded from rescinding his contract when he becomes of age by reason of the fact that it is physically impossible for him to return benefits thereunder. It sometimes happens that a contract has been partially performed during infancy, and that the minor has received some advantage therefrom. He may have received a sum of money for a piece of property sold by him, and have spent it before becoming of age. He may, nevertheless, recover the property from his vendee.

At first glance this appears to be a hardship, and it is a doctrine which is frequently criticised by laymen. It is founded, however, upon the very reasonable idea that one who deals with an infant, does so at his peril, a minor being, in the eye of the law, not competent to protect his own interests. The law takes care of this anomalous situation by allowing the appointment of a guardian for an infant, and through such guardian the infant may make all contracts which are necessary for his best interests.

Civil Disability.—In England and many of the United States, criminals convicted of felony are debarred from exercising civil privileges. Imprisonment for life is accounted civil death.

Mental Disability.—Mental disability may be either partial or total, permanent or temporary, and arise from permanent or acute causes.

One whose mind is clouded to such an extent as not to understand the nature of the act, is deemed incompetent to contract, whether such condition proceeds from insanity, intoxication or the use of drugs, and such contract is avoidable at the option of the person so incapacitated. While the rule, like some others stated herein, is occasionally modified in some jurisdictions, the prevailing rule in the United States has been given.

Compulsion.—A contract cannot be enforced against a person who is induced to enter into it by threats of personal injury to self or family, or of illegal detention or injury to property.

The foregoing considerations are somewhat technical; but they have been stated as simply as possible. For practical purposes, the most important points to remember, are the disability of infants and the limitation of the power of corporations. No important contract should ever be made with a corporation without legal assistance to discover first, whether the corporation has power to make the agreement, and second, whether such contract has been duly authorized by the directors, and authority delegated to the officer who attempts to bind the company.

2. Lawful subject-matter.

It is the policy of the law to allow the utmost freedom of contract, and no limitation is placed upon the right to contract save only that a contract may not be made to do an act which is forbidden by law, or one which is opposed to public policy. Thus, one cannot contract to erect a building in violation of the building law, nor to commit a felony or a misdemeanor. It is usually simple to determine whether the object which it is desired to effect is forbidden by law. It is not always easy to determine whether the object is contrary to public policy. Cases frequently arise which appear to be innocent upon their face, and which to the lay mind seem to have no bearing upon any individuals other than the parties to the contract themselves. Upon a closer inspection, however, it is seen that they affect the underlying principles upon which is based our system of government. Thus, it is the policy of the law that every man should be free to earn a living as he will; that trade should not be unduly hampered or constricted; that gambling should not be encouraged, that

necessities should not be monopolized or the price thereof unduly inflated. An agreement to do any of these acts is regarded in the light of a conspiracy and will not be enforced by the court. In many cases one who is not a party to the contract may prevent the carrying out of its provisions, if harmed thereby. It will often be found that this question of public policy will confront those who are considering contracts to restrict the use of patented articles, or to limit the area within which parties to the contract may practice their profession. These questions are always troublesome.

3. Definite offer.

All contracts are based upon an offer by one of the parties and an acceptance by the other. These are the preliminary steps, and present a variety of interesting questions. Thus, one offers to work for another and the contract is concluded by the acceptance of the proffered services.

The offer must be definite and, generally speaking, to a definite person. A vague offer makes either no contract at all, or at most, a very unsatisfactory one. In the interest of definiteness and clearness as a preliminary to a contract, the following warning may seem to be timely: a neglect to consider it is at the bottom of a large percentage of the difficulties arising out of contracts. One who proposes to make a contract must come to a clear understanding with himself in respect of what he really desires to accomplish. If he has a hazy, indistinct idea of the obligations which he is about to assume, or of those which he desires to impose upon others, he is almost certain to make an unsatisfactory contract, and end in litigation.

He must be careful not to confine himself to a consideration of present conditions. A contract of prolonged duration, which is acceptable to-day, may be objectional next year, but will not be in any degree less binding; dissatisfaction is not a ground for cancelling a contract. He should not be content to take the opinion of those with whom he is contracting as to what he desires, but will independently and carefully consider it from his own point of view, and, having once come to a conclusion, will not be moved therefrom in essential points. Foresight is that

quality which differentiates the successful from the unsuccessful man, and in making contracts no other quality is so much needed. A most frequent difficulty which is the subject of repeated comment by the courts in rendering their decisions, springs from the fact that one of the parties failed to give sufficient thought to the consequences of his agreements, or to anticipate conditions which a few moments' careful consideration would have made plain to him.

In stating that once having arrived at an opinion one should not be moved therefrom, it is not intended to counsel a spirit of uncompromising stubbornness, which would probably result in a failure to make a contract. Every agreement, when finally executed, usually contains concessions from the original propositions made by the parties, and one should be ready, after having determined what self-interest dictates, to make concessions at such points as are possible. But this should not be done lightly or unadvisedly. A concession made in a thoughtless moment and without due consideration, may mean years of litigation and financial loss. In making propositions or demands, however, it is essential to regard the interest of the other party to the contract. Fairness to others is one of the secrets of personal success. If, therefore, one approaches the making of a contract with an apparent unwillingness to regard any but self-interest, and an obvious desire to reap all the advantage possible without regard to the equities existing in favor of the other parties to the contract, though the negotiations may terminate in an agreement of some form, it will lack the surest guarantee of successful performance, mutual confidence and trust, without which the strongest contract may be turned into a bone of contention and the most promising prospects ruined.

Having definitely determined upon the offer, it must be communicated in any appropriate way, orally or in writing, by letter or telegram. In the interest of accuracy, however, the offer should, whenever possible, be reduced to writing.

The offer is a nullity until it is actually brought to the notice of the person to whom it is made, and may be withdrawn at any time before it is accepted, notwithstanding a voluntary statement

that it may remain open a definite time. Thus, an offer sent by letter may be withdrawn by telegram reaching its destination before the letter, or before acceptance.

4. Unqualified acceptance.

From the foregoing it is plain that acceptance should be prompt, if a contract is desired. Such acceptance must be of the exact terms of the offer. A counter proposition is not an acceptance and simply leads to further negotiations and a new offer. To constitute a contract, it must be possible for the one to whom the offer is made to say simply, "I accept your offer."

Like the offer, the acceptance may be communicated in any convenient form, but unlike the offer, the acceptance becomes binding the instant it passes beyond the control of the accepting party.

Thus, the instant an acceptance is placed in the mail, or dispatched by telegraph, it becomes binding and the contract is complete possibly some time before the acceptance becomes known to the maker of the offer. Thereafter it is impossible for either party to withdraw from the contract unless by consent. This fact, it will be observed, often embarrasses one who makes an offer and wishes to withdraw it. Cautious business men heed the advice of Sir Frederick Pollock, who once said:

> "The practical conclusion seems to be that every prudent man who makes an offer of any importance by letter, should expressly make it conditional on his *actual receipt* of an acceptance within some definite time."

5. Complete agreement.

Closely akin to the necessity of an explicit acceptance, is the rule that the minds of the parties to a contract must be in complete accord. This is known as the "Meeting of the minds of the parties," and no contract is complete without it. A contract, valid in all other respects, may subsequently be avoided or rescinded if it appear that the parties had not arrived at this meeting of the minds.

Such a situation arises when to all appearances the parties have agreed, but in reality have never come to an understanding. The cases when this occurs are generally divided into the following classes:

a. Mistake of fact.
b. Misrepresentation.
c. Fraud.
d. Undue influence.

a. Mistake of Fact.—It sometimes occurs that all the parties to a contract are misled as to the subject-matter of their agreement. Thus, a cargo of grain was sold while in transit by sea to London. It subsequently appeared that prior to the sale the cargo had been destroyed. It was held that the sale was invalid. Similarly, where a contract was made to dig a thousand tons of potter's clay yearly from certain territory, and it subsequently transpired that at the time of making the contract there was not so much as one thousand tons of clay under the land, the agreement was declared void. Again, A may agree to sell to B a horse (meaning a certain bay). B agrees to purchase the horse, supposing it to be another animal. No contract ensues. It is, of course, obvious that to avoid the contract, the mistake must be in respect to some vital, material point.

These mutual mistakes are comparatively rare and do not, ordinarily, cause great difficulty. Much more intricate are the questions involved in the following cases:

b. Misrepresentation.—It sometimes happens that one party, without evil intent, *unintentionally* misstates facts, or misleads the other party. This is known as misrepresentation, and must be carefully distinguished from fraud where the deception is intentional.

Where the misrepresentations occur in preliminary negotiations, they have no effect upon the validity of the contract, *unless* the relations between the contracting parties were such that they owed to one another some special duty of exact and explicit statements. Such is the case when the parties occupy a confidential relationship to one another, as that of principal and agent, attorney and client, and the like. Such a situation also arises where from force of circumstances one party must rely upon the other for his knowledge of the facts. In this case the other is bound to the utmost good faith.

But it sometimes happens that instead of the innocent mis-

representations being preliminary to the contract, they actually become an integral part of it, and the inducing cause for making it. The representation then amounts practically to a covenant or warranty, and, if false, may be made the basis for a cancellation of the contract. A single instance will suffice:

A, being about to sell a horse to B, *without any guarantee,* says "the horse is sound." B buys and finds a defect; he cannot rescind. But if A says, "I warrant the horse sound," and a blemish appears, the transaction is a nullity.

The practical application of this doctrine to business men is that they should show extreme care in making hasty or thoughtless statements in entering into a contract. Let all information which is given be such as may be substantiated by proof, and let no guarantees be made which cannot be performed.

This leads, naturally, to a consideration of a kindred nature. The surest way to promote litigation over a contract, and to land in an endless maze of trouble and difficulty, is to have a party to a contract fail to appreciate the true significance of what he is doing. We have adverted to the necessity of a complete knowledge of one's own position. It is equally essential that all parties should appreciate their responsibilities. It is a matter of frequent occurrence to have a client request his attorney to so phrase certain portions of his contract that he may create an obligation upon the other side which will not be suspected at the time the contract is made. Nothing is more foolish or shortsighted, and no wise attorney will accede to such a request. The reasons are obvious. If the obligation is one which should in fairness be assumed, it should be stated openly and frankly. If, on the contrary, it is of such a nature that the contract would fail of consummation if it were expressed in the instrument, an unfair advantage is about to be taken, and when subsequent to the making of the contract its true meaning is disclosed, it will result in one of two things. It may be that the agreement will have been inserted in such a skillful manner that it can be enforced, in which case the advantages gained therefrom will be at the expense of confidence and good will; or, as more frequently happens, the

contracting parties will be involved in a lawsuit, which may extend to the third and fourth generation of their descendants.

c. Fraud.—*Fraud is willful misrepresentation or suppression of a material fact made by one party with intent to induce another party to enter into a binding agreement, and which has such a result.* Fraud is always a complete ground for the rescission of a contract, and no agreement can survive its taint.

Every word in the foregoing definition is essential, and the elements of fraud are carefully stated. It must be willful and intentional; calculated to work injury, and result in it.

Cases of willful affirmative deception are comparatively simple. Usually the only question is as to whether such deception relates to a material point.

A much more difficult problem arises when we consider the question of a suppression of material knowledge. What facts is one bound to reveal in order to avoid the taint of fraud?

On the one side is the danger of fraudulent suppression of fact; on the other is the quixotic impulse to disclose all that is known, including legitimate special knowledge or business secrets. Thus one may buy a house, knowing of impending developments which may enhance its value. No obligation exists to disclose such knowledge. But if a man sells to another stock, which from special knowledge he knows to be worthless, it is as obviously a fraud.

Unquestionably, the line is a fine one between the two cases. But consider that in the second instance the seller by accepting payment impliedly sold something of value, and the case is practically similar to one of willful misrepresentation. Here then is the test. When the suppression of facts amounts to a false representation that they do not exist, then the element of fraud is present.

But, after all, the best safeguard to business men against charges of misrepresentation or fraud is a high standard of business ethics, which makes one willing to forego profits which might be gained by sharp practice or doubtful methods.

While such distinctions as have been suggested above are sometimes difficult to phrase in words, no man, whatever his

character, finds any trouble in practically determining whether his acts are such as conform to the generally accepted standard of moral duty. However far, personally, he may have departed from a high standard of personal rectitude, and however successful he may have become in stilling the voice of his conscience, that arbiter of duty never dies, and if questioned will, with the same certainty with which the magnetic needle points to the north, indicate conduct which would willingly be submitted for public approval, and that which would preferably be concealed from general knowledge.

Such words are not mere ethical theories, but point the way to the most practical test a business man can apply when in doubt about the legal aspect of a proposed course of action. Let the question be asked: "Would I be entirely willing to have such action generally known among my friends and business associates?" If the question can be honestly answered in the affirmative, no fear need be felt that the proposed course of dealing will ever be branded by the law as fraudulent or worthy of condemnation.

If the question be answered in the negative, it is certain that, while such method of business dealing may in any single instance add to pecuniary prosperity, it will in the long run mean loss of reputation and the confidence of the business community, as well as make extremely likely ultimate censure from the courts.

If error must be committed, let it be upon the side of overfairness to business associates rather than upon that of unscrupulous methods.

d. Undue Influence.

When an individual is so situated that the will has become subservient to another's to a point where independent action is practically impossible, such individual is said to be unduly influenced.

The most obvious example of such a condition is where one who is of feeble mental powers comes so under the power of a stronger personality as to yield unquestioning obedience. The dependent person need not be of unsound mind (which would make him incapable of contracting) in order to justify the court

in saying that agreements made by him, under such influence, lack the essential element of a complete meeting of the minds.

Such cases most frequently arise in instances of persons of advanced age, or in unusually dependent circumstances.

A contract entered into between such a person and the one who is in a position to unduly influence the judgment, by which the latter benefits, is always scrutinized minutely, and is more than likely to be set aside.

Sometimes this undue influence arises from the possession of a real or apparent authority, sometimes from the necessity or distress of the injured party. The result is the same.

When one who is to be benefited thereby, enters into a contract with another who is dependent upon him either for advice or assistance, it should be insisted that the contract be submitted to some disinterested person before execution. In this way will be avoided serious complications and charges of bad faith which may be as painful as they are untrue.

Duress, to which reference has been previously made, is sometimes considered in the light of an obstacle to the complete meeting of the minds, but the writer prefers to treat it, as has been done, as a condition which incapacitates the party affected by it, from entering into a valid contract.

6. Valid Consideration.

While the law does not concern itself with the details of contracts made for legal purposes, and will enforce them according to their terms, there is one element which is essential to their validity. Some return must be given for every promise made or right surrendered. This return is the *consideration* for the contract. It must be present in every contract in some form or another. If absent, the contract cannot be enforced, for it is clear that if one promise to do something for another, and receive no benefit from so doing, he cannot be forced to fulfill his contract. A few examples of the plainer or simpler character will make this clear.

1. A man agrees to build a machine for another who agrees to pay a stated price therefor. The contract is a valid one and may be enforced. The consideration for the promise to build

the machine is the promise to pay the agreed price, and *vice versa.*

2. A promises to build a machine for B, but B makes A no promise that he will either accept or pay for it. The contract is absolutely void and unenforceable. There is no consideration for A's promise.

These are simple forms and might, perhaps, have been given from general knowledge by any layman. All contracts, however, are not simple and it is often difficult, if not impossible, to determine whether a valid consideration has been given or not. Thus, it is not a valid consideration for one to agree to do what he is already under obligation to do. If A, therefore, promises to pay B a debt which is already due, it would not serve as a consideration for B's promise to build a machine, but, on the other hand, A might agree with B that if B would build the machine, A would, for a definite period, not compete with B in his business in a specified locality. This consideration would be sufficient.

To put it in its simplest form, therefore, if one desires to enforce a provision of a contract for his own benefit, he must make sure that he has given some value to the person with whom he is contracting, in return for the benefit he is to receive from him.

The first question, therefore, which a business man will ask himself when about to make a contract is, What will he give in return for that which he expects to receive? He must give something. What is given is not altogether material. The law will not pass upon the question as to whether *adequate* value is given for what is received further than to say that the relation between what is given and what is received must not be so disproportioned as to be palpably unfair or unjust. Thus, if one offers to sell a horse, and the buyer agrees to pay $50 therefor, it is a complete consideration, although the horse may really be worth $250. If, however, the buyer agrees to pay but $1, and the horse is shown to be worth $1,000, it would probably be said that there was no consideration. It must be at once apparent that this is a fruitful subject for discussion in the courts, although the usual determination is that the court will not pass

upon the adequacy of the consideration, so long as a consideration existed at all and is not unconscionably small.

The particular character of the consideration or value which is given for what is received, is not important. It may take a variety of forms. As has been previously stated, it may be the payment of a specified sum of money; it may be the performance of work or services; it may be an agreement to refrain from doing certain acts; it may be the suffering of some harm or detriment; it may be the foregoing of some legal right; but in the last analysis, something must have been given up, or the contract is unenforceable.

If a complicated contract is being negotiated, it may be that the real consideration which will support it is something totally different from the conception of the parties. It is the business of the attorney to see that this consideration exists, or is made to exist, and that it should appear in the contract. Many a valuable contract has been lost by reason of a failure to properly express the consideration. Let no one be deluded by the fact that a contract bears a seal, or that it contains the usual clause "in consideration of One Dollar." Both of these safeguards will prove broken reeds, if no true consideration exists.

Formalities Attending the Making of Contracts.

Mention has previously been made of the necessity of having contracts in writing. It was stated that it was not always necessary to have the written instrument of a very elaborate character. A few words in connection with the form of contracts may not be amiss.

Every contract should be signed by all the parties. A seal should be affixed for the purpose of raising the presumption that a consideration exists for the agreement. Originally, at common law, the seal was conclusive evidence of consideration, but the development of law has resulted in almost every jurisdiction in doing away wholly, or in part, with the distinction between sealed and unsealed instruments. A seal has the added effect of prolonging the time within which actions to enforce the contract must be brought. Thus, in New York, an action on a contract

without seal, must be brought within *six* years, while *twenty* years is given within which to sue upon a sealed instrument.

Contracts with corporations must always bear the seal of the company. It is the legal sign manual of the corporation.

The form of the seal is immaterial, and in most states a scroll, or the word "Seal" written by hand, is sufficient.

The question is frequently raised, whether it is necessary to have the signatures to a contract attested before a notary. If it is intended to have the instrument publicly recorded, it is in almost every jurisdiction necessary that it should be acknowledged. For instruments that are not to be so recorded, there is no absolute necessity either for an acknowledgment or for a witness. It is, however, desirable in every case to have a witness, if possible, and to have the paper acknowledged when it can be conveniently done. This springs from the fact that such a witness or acknowledgment facilitates the proof of the instrument. Every evidence of care in the signing of a contract adds to the force of its contents. In addition to this, the acknowledgment before a proper officer fixes absolutely the date upon which the instrument was in existence and in force. This is often a most important point. It is hardly necessary to say that every contract should be dated, and should contain in the body of it a clear statement as to the date when the contract became effective, its duration and its termination. All contracts should be executed at least in duplicate, and no one should ever allow any contract which has been signed to go out of his possession without retaining either such duplicate original, or a copy thereof which is absolutely correct. In these days of carbon copies, it is quite common to consider a copy complete which contains only the body of the contract. All original dates and signatures should also be copied upon the carbon reproduction.

Having considered the questions preliminary to or connected with making a contract, we now pass to the consideration of subsequent rights and liabilities thereunder.

Termination by Limitation or Consent.

It is quite possible that some change of circumstances may

occur which makes it desirable to terminate a contract, or some dispute may arise in respect thereof. Even this brief examination of contract law would therefore not be complete unless we gave some consideration to the methods of terminating a contract, and the cancellation of the rights and liabilities thereunder, either with or without the consent of all the parties thereto.

In practically every contract, executory in form, a date is fixed for its expiration. At such time all rights and liabilities under the contract cease, unless the agreement be further extended by mutual consent, or displaced by a new one. It is hardly necessary to say that a contract is terminated when fully performed, and may also be terminated prior to the time fixed for its expiration, by the joint consent of the parties thereto. If, therefore, it becomes apparent after making the contract, that it is mutually unsatisfactory, it may be so abrogated. No trouble will be experienced if the parties are in accord. A contract which has been made in writing should be cancelled with as much formality as was evidenced in the original agreement, and the parties thereto should make certain that they receive proper releases of all liability thereunder. In the same manner that a contract may be cancelled, it may be modified or amended by mutual consent.

Termination by Legal Means.

Serious difficulty arises, however, in respect of the alteration of agreements or their cancellation when consent cannot be obtained.

Notwithstanding all the precautions which we may take, it sometimes occurs that a party to the contract feels that he has been misled in entering into a contract; that he has not been fairly treated; that the contract, as drawn, does not represent the real intention of the parties, or that there has been some mutual mistake of fact made by the parties, which renders the contract unprofitable. In a still greater number of cases there is a violation of the terms of the contract for which redress must be sought. These questions are all interesting and will repay some consideration.

As we have seen in certain cases, a party to a contract may

rescind the entire contract and be relieved from further liability thereunder, even against the will of the other party to the agreement. The chief examples of this, some of which have been considered in connection with the subject of the essentials to a contract, are as follows:

1. Where it appears that there is no consideration for the contract.
2. Where the contract has been induced by fraud.
3. Where the contract is impossible of performance.
4. Where there has been a mutual mistake of fact in regard to the subject-matter of the agreement.

1. We have previously spoken somewhat at length of the necessity for a valid consideration in the contract. If it shall be found after the contract has been made, that no real consideration exists, the contract is unenforceable. Many examples of this will suggest themselves, for example: A might agree to perform some act for B in consideration of the latter's agreement not to compete with A in business in a certain locality. A might subsequently discover that B was already under agreement to avoid that territory, so that in fact B had given nothing which he was not already under obligation to perform. There being no consideration for A's agreement with B, he would be entirely justified in refusing to perform his part of the contract.

2. By far the most important ground for abandoning or rescinding a contract is that fraud has been present in its inception. If it be found, therefore, after making a contract, that a party has been willfully misled with intent to cause him to enter into a contract which he would not otherwise have made, he may cancel the entire agreement. It is difficult to prove the fraud which must necessarily be present in order to impair a contract. The essential facts which must be established are as follows: It must be shown first that false representations were made by the individual with whom the contract was made; that these representations were accepted and led to the making of the contract; they must have been made about a material fact and for the purpose of promoting the agreement. Most important of all, the individual making the fraudulent representations must be

shown to have known that they were false. This latter requirement is the most difficult to meet.

One who would rescind a contract upon the ground of fraud must return any benefits received under it. He must place the other party to the contract in the same position which he occupied when the contract was made. If, therefore, he has placed himself in such a position that he cannot do this, his right to rescind the contract is destroyed. The law will not permit a man to receive wholly or in part the benefits of the contract and escape the liability of performing his duty thereunder.

3. One may be relieved from a contract which is impossible of performance either at the time the contract is made, or by the happening of some subsequent event, provided it was not known at the time the contract was made that such impossibility existed. Otherwise, he may be held liable in damages for his failure to perform. Where, however, a contract is entered into innocently, the law will not permit a man to suffer by reason of the fact that performance is impossible. Mere difficulty of performance, although it may be great, and the loss which he suffered heavy, will not excuse performance, nor will a temporary impossibility.

4. Rescission on the ground of mutual mistake of fact has been sufficiently considered under a previous subject.

Upon any of the foregoing grounds, the contract may either be said to be void, or may be rescinded.

Reformation.

It sometimes happens, however, that the maker of a contract does not desire to go to the extent of rescission. Perhaps he feels that the contract, as drawn, does not accurately express the real intent had at the time it was made. In this event the aid of the court may be invoked to re-form the contract so that it shall accurately present the intent of the parties. This is always a more or less difficult task, however, unless the contract is clearly incomplete or insufficient. The general policy of law is that a contract in writing cannot be varied by parol evidence. That is, one cannot take a contract complete in itself and say that

something different from what is expressed therein was intended. There is only one case in which the court will allow this to be done. If the contract is ambiguous or insufficient in its phraseology, so that it cannot be determined from the instrument itself what the real intention of the parties was, the court will receive evidence upon this point and will readjust the rights and liabilities under the contract accordingly. The rules of construction will be considered presently.

Breach of Contract.

We now pass to the general question of breaches of contract and the results which follow therefrom. A breach of contract occurs when one of the parties thereto fails to perform a material part of the agreement. A failure in an immaterial or insignificant portion thereof is not a breach. The breach of a valid contract always gives rise to an action for damages sustained by such breach, and in many cases, if it be apparent that a breach of contract is contemplated, the court will interfere and before the breach be committed will prevent it by injunction. These two forms of relief must be clearly separated in mind. When the damages which follow a breach of contract may be measured and determined and the party causing the breach is financially able to respond in damages, the only remedy is to sue him at law for the amount of the loss which is sustained. If, however, such damages cannot be measured nor can any money which may be recovered recompense for the loss sustained, or where the wrongdoer is financially irresponsible, an injunction will lie to prevent the threatened injury. A few examples will illustrate this statement.

If A agrees to employ B at a fixed salary and refuses to do so, while B is ready and willing to perform his contract, it is clear that the damages which B sustains arise from the loss of his remuneration. Ordinarily, no action can lie against A save to recover the amount of the agreed compensation. Let us suppose, however, that A has agreed not to cut down a large tree standing upon his property which gives shade to B's house. It is clear

that if A does so, the damage cannot be repaired. If B sees A about to commit the violation, he may stop it by injunction. Again, A may have agreed with B to permit him to use his laboratory for scientific experiments. B cannot obtain the same accommodations or facilities elsewhere. His damage will be irreparable if A does not fulfill his contract. B may therefore restrain A from removing his laboratory and force him to permit the use of it. Again, suppose that A has agreed not to practice his profession in the same town with B, and proceeds to do so. It is clear that the damage sustained cannot be measured in money and the court will grant an injunction to prevent the threatened act. Lastly, suppose that A has agreed to give B an exclusive license to sell a patented article in a certain city, and B finds that A is encroaching upon such territory, while it appears that A is financially irresponsible. It is evident that although it may be possible to determine just how much has been lost through sales which A makes, which amount could ordinarily be recovered in an action at law, the fact that A is financially irresponsible will prevent such relief from being efficacious. A may be judgment proof. In this case the law will grant an injunction to prevent the unlawful act.

This power to go beyond the mere question of damages and to restrain by injunction is called the equity power of the court. It is very jealously exercised and may be only invoked where the ordinary remedies are unavailing. Nor can a man ever invoke the assistance of a court of equity, unless he is himself free from all blame in the premises. There are two maxims of equity which may be remembered with profit: "He who seeks equity must do equity" and "He who enters a court of equity must come with clean hands." Be the complaint ever so meritorious or the case sound at law, help will be refused unless the complainant can show that he is himself free from blame.

It must be remembered also that whether suit be brought at law or in equity the complainant must always show a readiness upon his part to perform his obligations under the contract. There are some exceptions to this rule, but they so rarely occur and are of such a technical nature that we need not consider

them. Benefits under a contract can never be claimed unless obligations be performed.

In some cases it may be that performance of a contract is prevented by the other party thereto, or that by his act performance of the contract has been rendered impossible. In any case one must be *ready* to perform if he would enforce his rights.

Thus, if one contracts to work for another, and employment is refused, the remedy is for the amount of the agreed wages or salary. But this amount cannot be recovered, should it appear that, upon the refusal to employ, the employee entered the service of some one else. In other words, he cannot receive double pay. If he recover his agreed wage he must deduct the amount received during the time for what the employer is held liable.

CONSTRUCTION.

We now pass to the last of the important considerations in regard to contracts, namely, the rules for the construction of such instruments.

The methods by which contracts are construed by the courts is a matter so closely within the sole knowledge of practicing lawyers that the layman is not qualified to pass an opinion upon it. Two or three examples will suffice to explain this. When two persons enter into a contract they have in mind not only the terms of the particular instrument, but, as well, a large fund of knowledge personal to themselves, which they read into the paper and perhaps feel may be omitted safely from its phraseology. Some facts they may deem to be so well known, both to themselves and to the other parties to the contract, that to express them would be surplusage. When, however, the contract is taken before a court of justice for interpretation, it may be found that the other parties to the contract have conveniently forgotten these facts and deny their existence, and the point at issue may be deemed by the court controlling. This is the situation which occurs in practically every contest over a contract. A sharp divergence of opinion is found as to what was really meant at the time of execution.

It is well, therefore, to make certain, before signing a contract, that its phraseology is so clear, its terms so explicit and its

contents so full that it may be submitted to any court, before which it may be brought, containing in the body of the instrument itself all the facts which are necessary to support the desired view of it.

It must also be remembered that many expressions commonly used in contracts have a widely different significance in a court of law from their popular meaning. Furthermore, it is frequently the experience of litigants that they find obligations imposed upon them by the terms of their contracts, and which are implied from provisions stated therein, which were never in contemplation at the time the instrument was made. It is a lawyer's business to pass upon all these points. If an attorney be wise, he will neither draw nor pass upon a contract until he has first satisfied himself of the surrounding circumstances, and in many cases of the details of his client's business, in order that he may judge whether sufficient is expressed in the contract to guarantee its enforcement in a court of justice. Points which may seem insignificant to the client may seem important to him, and so prove if the contract be under fire. No one, therefore, should lose patience with an attorney if he seem to ask questions which the client may deem irrelevant and superfluous. It is a sign that he is in good hands. It is much better that the attorney should know too much than too little. No attorney should ever be employed who cannot be trusted with the minutest details of a profession or work.

Many disputes arise from the fact that the parties to a contract are mistaken in their ideas of their obligations thereunder. Without advice they assume to act in a manner which they deem justified by their contract, but which in fact is in violation thereof. At times a failure to comprehend the true meaning of a contract may be excused upon the ground of the inherent difficulty of the case. More often, however, a few moments' careful consideration of the contract, prior to action, and even a slight knowledge of the rules by which such instruments are construed, would have prevented the violation. If, therefore, after making the contract the question arises whether a certain proposed course of action will be in accordance with the contract or in violation of its terms, the instrument must be considered, not in the light of personal wishes

or even of individual opinion. If a dispute arises between the parties to the contract it will not be settled by any such authority as this. The court will adjust the differences between the parties and construe the contract in accordance with well-established rules. An attempt must be made to regard the contract as the court will regard it. It is desired to give a few practical suggestions upon this subject.

In the first place, when a contract comes before the court for interpretation, examination will be made first of the instrument itself, for so far as the agreement is clear and unambiguous the court will give to it full force and effect, nor will it allow any explanation to vary or alter the explicit statements made therein. This is obviously upon the theory that the parties were presumed to know what they did at the time they entered into the agreement, and when their intention is clearly indicated it must prevail, however burdensome or disagreeable. Thus far the interpretation is comparatively free from difficulty. It frequently happens, however, that while the question in dispute is partially covered by the terms of the contract, the phraseology of the instrument is susceptible of two or more interpretations. It is then the province of the court to determine what was really meant by the language employed. There are a number of broad rules to guide the court.

1. The words will be given their ordinary and commonly accepted meaning, unless it appear from the circumstances of the case that they were used in a special sense.

2. Where the subject-matter of the contract concerns a particular trade or business, words having reference thereto will be given the meaning usually ascribed to them in such business or profession.

3. The court will take cognizance of particular uses or customs affecting the subject-matter of the contract.

4. The court will endeavor to ascertain from any possible source what the real intent of the parties was, and give force and effect to that intention.

This last rule is the most important of the four, and comprises in a measure the other three. If the court can once deter-

mine what the parties really meant it will conform the contract thereto, no matter what the actual phrasology may be. The first three are in reality aids to arriving at the last.

It frequently happens that the subject in dispute is omitted entirely from the contract, and the court is then remitted to the necessity of determining what is fair and equitable, having in mind the whole contract and the circumstances surrounding it.

In other words the court will say that if the question had come up at the time of making the contract, it would have been disposed of by the parties in general conformity with the rest of the agreement.

It is hardly necessary to say that it must appear that the matters omitted from the contract should have been included therein in order to justify the court in interfering. By that is meant that it must be so inseparably connected with the contract and so bound up in it that it may justly be claimed that it is implied in the instrument itself. Mention has been previously made of the fact that it frequently happens, in making a contract unadvisedly, that the parties find obligations imposed upon them by implication which they did not consider at the time the agreement was made. In passing upon such points as this the court applies much the same rules as in cases of ambiguity. In the last analysis they are determined by the intent of the parties and the principles of fairness and equity. If, therefore, a doubt arise as to obligations or rights under a contract, and the point in question is not found to be clearly stated in the instrument, the best test which can be applied, in order to determine action thereunder, will be to attempt to take the position and viewpoint of the other party to the contract. It should be considered whether from his standpoint the course of action which is proposed would be fair and equitable, and in accordance with the general intent, as disclosed from the whole contract. Let the question be asked whether, if the positions were reversed, such action would be permitted. If this be done honestly, both sides of the question will be argued with equal vigor, and an attempt will be made to arrive at a decision which is in accordance with what is fair and just. If the contract be called before a court of law and an attempt made to

justify a given action, the course pursued will be determined by these principles, and their dictates might as well be observed before as after. Incidentally much trouble will be saved.

It is a difficult thing to take an unprejudiced view of facts in the face of personal interests, but the attempt to do so should be made, if not from higher motives, because it is certain that in the long run it is more profitable to do so. Above all, one should not be carried away with the idea that because a contract may seem without flaw or defect it will prove sufficiently strong to justify an act which is not in accordance with these principles or which will make it possible to obtain an undue advantage over an associate.

Conclusion.

Such are the salient principles of the law of contracts. There remain only one or two observations, which are in the nature of general advice.

Above all avoid, if it be a possible thing, litigation over contracts. It is better to surrender at times very substantial advantages rather than to undergo the dangers and difficulties of a lawsuit. Though one may win eventually, it too often occurs that, despite the best efforts of the most competent attorneys, the ultimate victory will be fruitless. Litigants are involved in heavy expense and tedious delay. Their business may, meantime, be at a standstill, and they may, while in pursuit of fancied gain, lose very substantial present advantages. Like every other business question, when one is faced with litigation he must weigh whether the advantages which he will gain outweigh the certain disadvantages which he incurs.

Unfortunately, there are too many cases where litigation cannot be avoided in justice to one's own rights, and with proper regard for one's own interests. The number should not be increased unnecessarily. He who is forced, however, into litigation, should make up his mind to pursue it until he has either obtained his rights or a final decision of the highest court is rendered against him.

The writer has endeavored in presenting this subject to give only general principles, and to avoid embarrassment by technical details or a discussion of the more complicated points. In some instances, principles which have been explained are subject to minor exceptions. As it is especially desired to make these notes of practical benefit, it will be found that at times the writer has not been content to simply state the law, but has made suggestions as to its application in everyday affairs. Technical accuracy has not been sought so much as a simple exposition of general principles, which at best are sometimes puzzling to the lay mind.

The most satisfactory result which could follow the publication of the foregoing pages would be to provoke the comment that they set forth nothing more than principles of ordinary right conduct and common sense. Of these the law should be, and aims to be, the exponent.

It is obvious that the principles of the law, however well fixed, must be applied to such a wide variety of cases that they appear to assume different forms. It sometimes seems to the layman that distinctions made by courts and lawyers are more fancied than real, and at times the application of legal principles seems in individual cases to work hardship. It is only a superficial observer who joins the ranks of those who would complain of the technicalities of law, of the difficulties and delays in its administration. The science of law is founded upon theories and teachings which are above and beyond any individual case. In the last analysis, the law is based upon ideas of fairness and justice which have been in process of development from the time when the Mosaic law was declared. If one could be absolutely certain that he could determine in any given case that which was absolutely fair, honest, straightforward, and equitable, and in accordance with the greatest public good, he could be perfectly sure that ultimately his view and actions based thereon would be sustained by the courts of last resort.

The greatest lawyers have been those whose first thought in any case brought before them was always, "What *ought* the law to be?" It is said that Daniel Webster before he would accept a retainer always considered, not whether he could successfully

urge the contention of his clients but whether such contention ought to be sustained. If he could answer this question in the affirmative, he accepted the case; if not, he refused it. Almost all litigation in the last analysis arises out of an attempt by one or more of the parties concerned to act in defiance of the abstract principles of justice referred to. If, therefore, a man desires to be successful in his relations with those about him, which is only a broader definition of contracts, he should be certain that he so rules himself that he not only serves his own interests but that he respects the rights of those about him. It is a mistaken impression prevalent in the minds of many that the only duties which are owed to our neighbors are those which are enjoined by printed statutes.

Before the statutes were ever conceived the principles which they set forth were found in the moral law, which contained and contains not only those matters which have become the subject of legislative enactment, but also those ideals of duty and uprightness which cannot be set forth by written words, and which speak most loudly and with a most conclusive force in the individual conscience. To think that these latter may be ignored with impunity is a false idea. Sooner or later in the affairs of business, men will be called upon to square their actions with these precepts. If they are unable to do so the chance of ultimate success is small; but conscious that he has acted in accordance with their teaching a man need not fear to submit the contracts and agreements of daily life to the judgment of any tribunal.

AGENCY

By

Howard E. White

In notes previously prepared, the general subject of contracts has been considered, and an attempt made to give in a not too technical form the general principles which underlie all agreements. If these have been mastered it is now possible to proceed to a consideration of some special forms of contracts which the business or professional man is most frequently called upon to make. The general principles are common to all, but, in addition, each variety of contract gives rise to special rules, which must be considered.

One of the most common acts of everyday life is to delegate authority to another, for some more or less general purpose. A moment's consideration will disclose to anyone how frequent this act is. It is often done so casually as to escape notice, but from the act of sending a street urchin to buy a morning paper to the broad power of attorney which the multi-millionaire gives to his confidential secretary the principle is the same, and the two operations stand side by side before the law as the establishment of an agency. Let the terms which we are about to use be clearly defined.

A Principal is one who delegates to another the authority to represent and act for him.

An Agent is one to whom such authority is delegated.

Agency is the relationship existing between Principal and Agent.

An agency may be either *general* or *special*, depending upon the scope of the powers granted. It is general when the agent is empowered to represent his principal in all his affairs, or all his affairs of a particular kind. It is special when the authority is of any less extent.

This distinction is of the utmost importance to consider, for it must be remembered that the relationship of agency concerns not only the principal and agent, but also those with whom the

agent deals in behalf of the principal. If the agent's authority to bind the principal is to be in any way limited, great care must be taken that the limitation be apparent to outsiders.

The key to the relationship of agency which unlocks many doors, and makes simple the problems presented, lies in the consideration that the act of the agent within the scope of his authority is the act of the principal, as truly as though it had been personally performed, and once performed the agent disappears from the operation, and leaves the principal alone involved. Much of the difficulty of the subject arises from a misapprehension of this fact. The agent is the *alter ego* or other self of the principal, and the law makes no distinction as to the liability of the principal between acts personally performed and those done by a duly authorized agent.

It will at once be seen what an important subject agency is, and how great should be the care used in selecting an agent.

Why Is Agency a Contract?

At first sight it seems somewhat strange to denominate such a relationship a contract, but a moment's thought will show that the agreement of the agent to represent the principal, and of the principal to employ the agent, forms an obvious contract, for which the consideration is the remuneration received by the agent and the benefit received by the principal from being able to delegate certain duties to another.

Establishment of Agency.

An agency, like almost every other contract, may be created orally or by written instrument. The authority may be conferred either before the act contemplated or, in some cases, by a subsequent approval and ratification of a previously unauthorized act.

Let us suppose that A, without authority from B, should go to C, and purporting to represent B, purchase a stock of merchandise; A or C then notifies B, and the latter acquiesces in A's acts. B thus ratifies A's acts and becomes bound thereby. Disaffirmance of an unauthorized act must be prompt and complete if liability is to be avoided. It need hardly be said that ratifica-

tion can only be predicated upon full knowledge of all the facts involved. Sometimes an agency is implied by operation of law, as where one person knowingly permits, without objection, another to hold himself out as a representative, and to enter into agreements in his behalf.

Relationship Involved in Agency.

A consideration of the relationships arising out of agency falls naturally under three heads:

a. Relationship between principal and agent.

b. Relationship between principal and third persons with whom the agent deals.

c. Relationship of the agent to third persons.

These three will be considered in turn:

a. The extent of the agency depends entirely upon the agreement between principal and agent. It may be as broad or as narrow as the principal pleases, but it should always be clearly defined, otherwise endless trouble ensues from the commission of unauthorized acts. In all but the simplest cases the scope of the agency should be defined either by formal power of attorney or by a memorandum in writing.

An agent who is authorized to accomplish a given result is usually considered, by implication, to be possessed of authority to do any act necessary to effect such end in a reasonable and prudent way.

Practically speaking, the more indefinite the language defining the power of the agent, the broader and more general will be his authority, and conversely, the more explicit the language, the more closely will the agent be held to its terms. It is a common error for one who wishes to give a general power of attorney to make great efforts to enumerate every conceivable act which may be performed. Human foresight being fallible, the probability is that the one essential act will be omitted, with the result that the very explicitness defeats its own ends and the agent is confined to solely what has been enumerated. A half a dozen lines giving a general authority to act for the principal in every case, and enumerating almost no specific instances, would,

in general, result in granting a power so broad that little could be deemed beyond its purview.

Principal.—The principal owes to his agent the duty of paying the agreed remuneration for his services; of performing the agreements which his agent shall lawfully make in his behalf; and of saving the agent harmless from any personal liability for such acts.

Agent.—The agent owes to the principal the duty of faithful performance of the acts committed to him, with reasonable diligence and prudence. He cannot make personal profit from his acts as agent; all such profits belong to the principal. He occupies a position of the utmost responsibility, and is held to the highest measure of good faith.

For a breach of these duties he incurs not only the danger of having his principal refuse to accept his acts, and so becoming personally responsible to those with whom he has dealt, but he may also be held liable to the principal for losses resulting from his acts.

The only safe rule for an agent to pursue is to make absolutely certain that he clearly understands the limits of his authority, and then to transact the business entrusted to him with an eye *absolutely* single to his principal's interests. The thought of his self-interest must never swerve him a hair's breadth from his duty to the principal.

It may sometimes occur that an agent will derive personal prestige from successful accomplishment of his principal's business, but he should never, without his principal's consent, derive pecuniary profit other than his agreed recompense.

b. Principal's relation to third persons. These may be very briefly stated.

So long as the agent does not exceed his authority, the principal is liable to third persons for every act which the agent may perform to the same extent as though such acts had been done in person.

In addition, a principal is sometimes held liable to third persons for unauthorized acts of his agent, if guilty of carelessness or negligence in permitting his agent to perform such acts.

An agent's unauthorized acts may take several forms:

1. He may do an act totally unconnected with his agency, and which could not be considered by any prudent man as incident thereto. For such acts the principal is never liable if he promptly disavows responsibility.

2. The agent may commit an unauthorized act which is in some measure related to his real duty and might reasonably be considered to be a part thereof by one not fully cognizant of the limitations of his authority.

The question then is, whether the principal is bound by such an act. The answer is not altogether simple, but must be determined by the following test:

The principal is bound by all acts of the agent which are within the scope of the authority which the agent reasonably appears to have. In other words, the principal, to protect himself, must see that he never knowingly permits his agent to act in a way which would justify the public in supposing that the agent had powers which in fact he did not possess.

This seems a somewhat harsh doctrine, but it is based upon the theory that if one takes the risk of delegating power to another he must be willing to accept all the reasonable consequences of so doing.

3. An agent sometimes purports to act for a former principal after his authority has been revoked. What is the liability of the former principal?

A general agency once established is presumed to continue until notice is given of its termination. That is, when a third person has been in the habit of dealing with an agent, he is justified in continuing to do so until notified that the agency is at an end.

A principal is bound, therefore, if he would terminate an agent's power, to take every precaution possible to a reasonably prudent and cautious man, to notify all those with whom the agent has been dealing that the relationship is at an end. Otherwise, a principal may sometimes find that a former agent has involved him in liability and expense.

c. Relation of agent to third persons.

When an agent obeys his instructions and does not exceed his authority, and *lets it be known that he is acting as an agent,* he incurs no personal liability whatever.

He may be held personally liable, however, for unauthorized acts which he commits, upon the theory that, having agreed to do something beyond the scope of his authority, it became in effect merely his personal venture.

It sometimes happens that an agent, even though he be acting within the scope of his authority, neglects to tell the person with whom he is dealing that he is an agent. That is, he, to all appearances, is acting on his own behalf. If he does so, such third person has the option of holding liable *either* the agent or his principal, upon discovering the latter's identity. It will thus be seen that it is extremely unwise for an agent to conceal his real standing. It may result in heavy personal liability. If the exigencies of the principal's business require that his name should be concealed and the agent be the apparent party in interest, the agent should require ample security for assuming the risk involved.

Principal's Liability for Agent's Wrongdoing.

Heretofore we have treated of the agreements or contracts which an agent may make or purport to make for his principal. There is, however, another point to be considered.

It sometimes happens that an agent inflicts actual physical damage either to the person or property of a third person. Thus, a truckman may so carelessly and negligently drive his employer's wagon as to cause injury to life or property. What is the employer's or principal's liability?

It is closely akin to that arising out of the agent's agreements or contracts.

If, when the accident occurred, the agent was engaged in doing that for which he was authorized, then his principal is liable for any carelessness or negligence of which he was guilty.

A good example of this doctrine has recently come before the courts:

A chauffeur, using an automobile in accordance with his em-

ployer's orders, negligently runs over and injures a man. The employer is liable for damages. But let us suppose that the same chauffeur, knowing that his employer is away, uses the automobile to entertain a party of his own friends, and while so engaged negligently causes an accident. His employer is not liable. The reason for this is, obviously, that in the first case the agent or servant was engaged in the business which his master directed him to perform, while in the other he was acting in violation of his duty.

So it will be seen that when the agent is acting within the scope of the authority which he apparently possesses his principal is responsible for all the results which follow therefrom, even though such results shall occur by reason of the carelessness of the agent. Here again will be seen the doctrine that if a principal entrusts to another a duty which he would otherwise personally perform, he must stand responsible for the acts of that individual.

Duration of Agency.

Like other contracts, an agency may be for a definite time or purpose, or it may be unlimited in duration. If the term or purpose of the agency be defined, it is obvious that at the expiration of the date or the performance of the designated duty the relationship terminates. If the agency is for an indefinite time, it may be terminated at any period that the principal or the agent choose, but it is, of course, obvious that the right to terminate when exercised by either the principal or agent against the wish of the other must be so exercised as not to inflict unreasonable harm. Thus, a reasonable notice of the intent to terminate an agency should be given.

There is one exception to the right to terminate an agency without mutual consent. It sometimes occurs that an agent is given by his principal an interest in the business, which he is delegated to perform. Thus, an agent may be authorized to erect a certain building and be given as recompense a commission upon the cost. It would be obviously unfair to arbitrarily terminate this agency and deprive the agent of his interest therein. In such cases as these, where the agency is said to be coupled with an

interest, it cannot be terminated without the consent of the agent. Of course, even in this instance incompetency or other misbehavior on the part of the agent would justify its termination.

An agency is also terminated at times by law. Thus, an agency to rent a particular building is terminated if the building be destroyed. So, the death or insanity of either principal or agent terminates the relationship.

Capacity of Agent and Principal.

Anyone who is legally capable of entering into an agreement is capable of employing an agent to do the same act. In default of such capacity in the principal, the agent has no authority, for it is clear that no person can transmit to another power which he does not himself possess.

The inquiry as to the capacity of an agent is easily solved. Anyone who is physically or mentally capable of doing the act which he is authorized to do is capable of assuming the relation of an agent, irrespective of whether he would be able to personally perform the act in his own behalf. Again will be noted the fact that the agent simply stands in the position of his principal.

Practical Suggestions.

The foregoing gives a most fragmentary and condensed statement of the very important law of agency. It will have served its purpose, however, if it shall have disclosed the danger which an individual encounters when authority is delegated. In order to avoid repetition, much that is said under the general head of contracts has been omitted from the subject of agency. The two sets of notes must be read jointly.

It is of the utmost practical importance, however, to all business and professional men that they should have a true understanding of the power which they place in the hands of subordinates. It is a most customary thing to see employees placed by their superiors in positions of responsibility and in representative capacities where their power for harm is unduly great. Often, without the presence of any dishonesty, incompetency makes possible loss and serious embarrassment. Every employer, therefore,

should scrutinize with extreme caution the work which he requires of his subordinates, particularly of those who are frequently away from his direct supervision. No subordinate should ever be permitted to make contracts or agreements for his employer until time and experience shall have proved his ability and worth. It frequently happens that an employee is given the authority to do an act which is harmless in itself, but which may justify the person with whom he deals in assuming that he possesses much wider power. Great care should be taken to avoid this serious situation.

So far as the agent or employee is concerned, the problem is a much simpler one. So long as he makes certain that he possesses a thorough understanding of the duties which are required of him, and is always in a position to disclose the fact that he is acting in a representative capacity, he incurs no serious legal danger.

PATENTS AND PATENT LAW

By

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Definitions. A patent is a grant by the government of the exclusive right for a limited time to practice an invention as claimed in the patent. It is a contract between the inventor and the government, in which, in consideration of the grant of the monopoly to the inventor, he must so describe his invention that a person skilled in the art to which it relates may from such description successfully practise the invention.

No Natural Right to an Invention. It must be borne in mind that no person has a natural exclusive right to inventions which he may make. For instance, suppose in the early days of agriculture that a man invented a plough, using it in place of the former crude methods of turning up the earth, and made and used such a plough within sight of his neighbors. He would not have been injured had his neighbors at once copied his ideas and made and used other ploughs similar to those which he was using. He would still have the right to use his own plough to the extent of his ability over all the lands that he could control, and would lose nothing by the acts of his neighbors. Nevertheless, every man who has invented a new device feels that it belongs to him, and the government takes advantage of this natural feeling of ownership in intellectual conceptions to secure the use of such inventions for its citizens by holding out to the inventor the lure of a monopoly for a limited time.

Value of the Patent System. Probably nothing has so contributed to the advancement of the United States as an industrial nation as the patent system under which inventors have been protected in the use of their inventions. It has given to every poor mechanic an incentive to improve his work, to every manufacturer an inducement to develop the skill of his artisans and employees, and to capitalists unusual opportunities for profit. It has built up industrial communities in portions of the country where agricul-

ture is naturally a failure, and has so improved the arts that household living has been cheapened in every direction, and comforts and conveniences have been multiplied to a degree unknown to any other community in the world. Probably every industry in the United States at the present time is based more or less upon patents, although in many industries, as, for instance, in flour milling, the earlier patents have all expired and have now become public property.

The laws relating to patents, their acquisition and utilization, are all contained in Acts of Congress governing the subject, and litigations relating to patents are within the exclusive jurisdiction of the United States Courts. Neither the State Legislatures nor the State Courts have any jurisdiction over patents or litigations concerning them, except in a collateral way.

Statutory Requirements. Without citing the statute, it may be generally stated that the law requires that in order to be patentable a thing must be an invention or discovery; it must be new, it must be useful, it must be an art, machine, manufacture or composition of matter, or an improvement thereof. It must not be known or used by others in this country before its invention or discovery here. It must not have been patented or described in any printed publication in this or any foreign country before its invention or discovery here, or more than two years prior to the application for patent, and it must not have been in public use or on sale in this country for more than two years prior to the application, and it must not have been abandoned.

At first sight, these prerequisites seem readily comprehensible to anybody and to be couched in plain language, but the rights involved in patents have become so vast and important that the ingenuity of lawyers has been expended in the interpretation of these simple sentences, so that a vast body of constructions and decisions has grown up around them, and in many cases it is difficult to determine just how they may be applied to any particular case in hand.

In patent law the words "invented" and "discovered" mean the same thing, although colloquially they are often given a different interpretation. They do not mean the same thing in England.

In the United States to be an inventor a person must be the *intellectual conceiver* of the idea embodied in the invention, while in England it is only necessary that he should be the possessor of the invention, whether he originated it or not, and be the first to introduce it within the Kingdom.

All new and useful inventions or discoveries are not patentable; for instance, a novel way of squaring the circle or computing the area of an irregular figure, or a system of bookkeeping, or of recording facts, or a new method of levying taxes. An extreme case occurred when it was held by the court that the art of producing insensibility in the human body by the administration of ether was not patentable. This was because the inventor did not invent ether, but only found out that when it was used it had the new effect. It was held, however, that he was entitled to a patent upon the novel *means* employed best to administer the anæsthetic.

Patentable Things. The things which are patentable are arts, machines, manufactures and compositions of matter.

An *art* or *process* is a *way* or *method* of doing something in distinction from the *means* made use of in doing it and the product which results from so doing. For instance, in the manufacture of car wheels it is desirable that the body should be of a cheap material, like cast iron, and the rim of a more expensive and stronger material, like steel, and the problem presented was to so unite the steel rim to the cast iron body as to make a structure which was practically homogeneous and not liable to separate under stress of wear along the line of junction. To that end an inventor devised a method whereby a circumferential gate of sheet iron was placed at the line of separation of the metals which were poured into molds on opposite sides. Each metal was simultaneously molded in place and the gate was gradually melted, and the surfaces of the steel and iron were thus united together into a unitary structure.

Another example of a process is as follows: As is well known, butter has long been separated from cream containing it by churning. An inventor discovered that by pouring cream upon a porous surface, such as blotting paper, the watery constituents

of the cream would be absorbed by such surface while the butter fat would remain unabsorbed, whence it could readily be removed without churning and without the expenditure of any mechanical energy.

A *machine* is an assemblage of bodies used to transmit or modify force for motion. In this broad sense a hammer or a lever is as much a machine as a complicated mechanism, like an adding machine or a steam engine.

A *manufacture* is a product complete in itself and distinct from the process by which or the machine in which it is made. Thus, a piece of cloth or a lead pencil are both manufactures, and this is so whether they are used merely in the making of other things or not. For instance, a watch spring is only useful when properly assembled with other parts in a watch mechanism, but, nevertheless, it is a manufacture complete in itself. It is obvious that the word "manufacture" also includes the simpler form of machines, such as mechanical tools, like hammers, chisels, gimlets and saws.

A *composition of matter* comprises new compounds brought together to accomplish some useful purpose, like, for instance, gunpowder, celluloid or rubber. In general, it includes all composite articles composed of two or more substances, whether they are the result of chemical union or of mechanical mixture.

Requisites of Patentability. To be patentable any of these arts, machines, manufactures or compositions of matter must be useful and new and must constitute inventions.

Utility. In patent law the word "useful" means not frivolous or pernicious. It means that the function performed by the invention must not be injurious to the morals, health or good order of society, but its utility need not be greater than other things of the same general class, and it need not be perfect in the performance of its function. Other things may perform the same function better, but that does not affect the utility of an invention which performs any function at all in a way which may be taken advantage of by a person desiring to use it. A toy, for example, is useful in the sense that it serves to amuse if not instruct children and others having correspondingly undeveloped

intellect, and a thing which is merely beautiful is useful in the sense that it serves to decorate and render pleasing the object to which it is attached or in which it is incorporated.

Novelty. An invention to be patentable must be new, that is, must not have been known or used by others in this country before its invention or discovery here, or patented or described in any printed publication in this country or any foreign country before its invention or discovery here or more than two years prior to the application for a patent, and it must not have been in public use or on sale in this country for more than two years prior to the application for a patent, and it must not have been abandoned. It will be seen, therefore, that the question of novelty divides itself into several subdivisions.

It must not have been *known or used* by others in this country before its invention or discovery here. It may have been known in a foreign country, and very generally known, but if that knowledge was not embodied in a printed publication or in a patent, whereby it could become accessible to the American public, it does not avail to anticipate a patent on the invention here. The courts have even gone so far as to hold that although there might be a number of people in this country who actually knew the invention that, nevertheless, the invention was not anticipated unless it had been put into *use* in this country. In other words, the courts have construed the expression "it must not be known *or* used by others in this country" as though it read "it must not be known *and* used by others in this country," and singular as it may seem, giving to the word "or" the meaning of the word "and" has not been an uncommon thing in our judicial procedure.

If it is sought to negative the novelty of a patent by a *printed description* or by a *prior patent,* such printed description or patent must contain a description of the invention just as clear as that which is contained in the patent sought to be anticipated, and it must contain a description of the same invention and not of a similar one. The test to be applied to such an anticipation is, can a person skilled in the art to which it relates reproduce from the alleged anticipating description exactly the thing covered by the patent? If he cannot, and if he has to supply omissions and use

his ingenuity in devising means to make clear ambiguous statements in the prior printed description then an anticipation does not exist. It has also been held that if the prior patent or prior description comprises both descriptive text and illustrations, that the illustrations without the text and the text without the illustrations are not sufficient to serve as an anticipation. The writer does not believe, however, that this rule would be followed if illustrations in such a case included technical conventional representations of things which would require no textual description to supplement them to make them clear. It might further be added that no printed publication is an anticipation if it has only been printed for *private* circulation or for distribution to a limited class of people.

It also makes no difference whether the inventor knew of the existence of the anticipating device or not. The patent laws are intended to serve as a reward for producing things which are new, and if they are old to other people they cannot be new in any proper sense, although they may be new to the inventor who devised them for the second time.

The device must not have been in *public use* or *on sale* for more than two years prior to the application for patent, and it must not have been abandoned. First, as to actual abandonment. Of course, this may be done by an inventor with the idea of giving the public a full right to practice his invention. This, however, seldom occurs. The difficulties which arise in connection with this matter are those which result from delay in making an application for a patent. If an inventor after having reduced his invention to practice delays a long while in making an application for a patent, it has been repeatedly held that such neglect constitutes an abandonment, unless it is fully excused by circumstances over which he really had no control; for instance, extreme poverty of the inventor, or mental or physical disorder great enough to generally incapacitate him for business. No delay constitutes an abandonment if during the time of such delay the inventor is endeavoring by experiment to perfect his invention and make it more useful, but a delay of several years between the perfection of the invention and the filing of an application for a

patent, taken for the purpose of profiting by practice of the invention in secret is such delay as will constitute an abandonment, even if the inventor always intended to apply for a patent when he could maintain secrecy no longer.

Placing the device in public use or on sale for more than two years prior to the application for a patent, as we have stated, negatives its novelty. What is public use is a question rather difficult to determine. If the inventor allows his invention to be used by other people generally, then, of course, it will be a public use; but an experimental use, even if such experimental use is *in* public, if conducted in good faith for the purpose of testing the invention and for no other purpose, is not such use as will negative the novelty of the patent. If, however, the main object of the use was profit to the inventor and improvement was only an incidental purpose, the use is not experimental in the eyes of the law, but is a public use. Public use by a stranger without the knowledge of the inventor more than two years before the inventor applies for a patent, constitutes just as much a public use as though it were by the inventor.

A device is said to be *on sale* if it is offered for sale, whether any specimen of it is actually sold or not. If an inventor furnishes a specimen of his device for use on approval, to be paid for if successful, it is on sale if the use is successful and the device is paid for, but if the use is unsuccessful then it cannot be said to have been on sale. It is obvious, of course, that an inventor may make a thing long prior to the period of two years and may keep its use secret. Such use would, therefore, not be a public use, and if he did not offer it for sale during this time it would not be on sale, and consequently, the circumstances would not warrant declaring the patent invalid for that reason.

Invention. A thing to be patentable must constitute an invention. So far as is known to me no court has ever defined the term "invention" as used in the patent law, but the courts have in hundreds of decisions decided that certain things do not constitute inventions, and from these negative expressions the rule must be deduced as to what an invention really is.

Technical skill is not invention, and by this is meant the tech-

nical skill of the trained engineer, electrician or chemist, as well as that of the mechanic. For example, if a weight has been used to produce a constant tension upon some moving part in a machine, and it became desirable to economize space, any engineer would naturally suggest the use of a spring in place of the weight. In a similar manner any chemist would suggest the use of certain reagents to attain certain results which might seem marvelous to a person uninformed concerning chemical processes. The courts have held as a criterion of invention that where the line between it and technical skill is narrow, if a particular result was long desired and sometimes sought but never attained in a particular art, want of invention cannot be predicated of a device or process which first attained the desired result, on the ground that the means by which the result was secured were so simple that many people (after the event) believed that they would have produced it if the desirability of so doing had been called to their attention.

It is not invention to produce a thing which differs from similar things in the prior art only in *excellence of workmanship*. For example, if an article has been badly made, it is no invention to make it better, or if it has been made with a rough exterior it is no invention to make it smooth. Mechanical skill is treated in law as the ability to plan improvement, and it is obvious that sometimes mechanical skill will become invention, but excellence of workmanship in law is merely the ability to execute an improvement which has been planned.

It is no invention to *substitute superior for inferior materials* in making a device or any of its parts. This seems quite obvious. For instance, the substitution of porcelain for brass in door knobs or of iron spokes for wooden ones in a wheel or the use of a *coffee* mill to grind *corn,* have all been held not to constitute inventions. But there are important exceptions to this rule. If the substitution of materials involves the development of new properties and uses, it may amount to invention. For instance, the substitution of rubber colored to resemble flesh (and which was not oxidizable) for metal as the material out of which plates to hold false teeth were made, was held to constitute an important invention.

Mere change in *size, form, degree* or *position* of the parts of a device without materially changing their function will not constitute an invention. For instance, using powdered glue in place of flaked glue, changing the position of the propeller of a boat from the rear to the front of the boat, increasing or decreasing the size of a saw to do finer or coarser work have all been held not to constitute inventions. An exception to this rule occurs where the mere change in size or form creates a new and unexpected function. For instance, prior to the invention of the carbon electric light filament by Edison, which was less than one sixty-fourth of an inch in diameter, similar filaments of larger size had been employed, but the reduction of the cross sectional area of the filament to the size mentioned enabled a subdivision of the electric current to take place which had not theretofore been possible. Consequently, the court, passing upon this invention, held that the change in size, accomplishing an entirely unexpected and useful result as it did, was entitled to be ranked as an invention although ordinarily such would not be the case.

An *aggregation* of machines or parts, or other arrangement in succession, to perform each by itself the function which they previously performed alone does not constitute an invention. For instance, the Supreme Court of the United States held that there was no invention in adding the usual erasing rubber tip to a lead pencil although it was convenient, useful and new, because there was no joint action between the two things thus assembled. That is, the presence of the pencil did not help the rubber in its erasing function, and the presence of the rubber did not help the pencil in its writing function. It should be stated, however, that if two machines thus brought into juxtaposition require a novel means for coupling them together, invention may reside in such coupling means.

Mere *duplication* or *multiplication* of parts does not constitute an invention. Single saws being in common use, it was held that no invention resided in mounting a number of saws upon the same axle in order that they might be simultaneously employed in cutting strips from the same piece of material. It has also been held that it constituted no invention to place two needles in the

ordinary holder of a sewing machine whereby two rows of stitching were simultaneously made where previously one row only could be made.

The *omission of a part* does not usually constitute an invention, unless the function of the machine remains undisturbed or is better performed when the part is omitted. If, by the omission of a part, economy results and the machine from which it is omitted has lost none of its efficiency, invention will probably be predicated upon such omission. But if the omission of the part means omission of the function which it previously accomplished, such omission must necessarily not constitute invention.

The *substitution* for one of a series of elements in an invention *of another element* which performs an *equivalent* function is not an invention. For example, suppose that it has been desired to place a constant tension upon an element in a machine which has been secured by means of a weight. The removal of the weight and the substitution of a spring which will accomplish the same purpose is not an invention. In the same way, in chemical compositions frequently an element of a group or series may be replaced by another element of the same group or series with no change in function. Thus, soda may be substituted for potash, lime for magnesia, and the like.

It does not constitute an invention *to use an old thing for a new purpose,* unless the new use is non-analogous to the old use. For example, an inventor devised a method for preserving fish by placing the fish in a chamber from which the air was excluded and which was surrounded by refrigerating material. The Supreme Court of the United States held that this was a mere new use of the old and well-known use of an ice cream freezer, and consequently did not constitute an invention. If the use is in a non-analogous art, however, it may constitute an invention. Suppose, for example, that a tool useful in roofing could be reduced in size and adapted for winding a watch—the new use might be patentable on the ground that the arts of making roofs and winding watches were so far apart that invention might be predicated upon such novel use.

It ought to be said that the Patent Office is not so particular as

the courts in subjecting inventions to the tests which we have outlined, and that patents are frequently issued by the Patent Office which do not pass unscathed through such tests when they are brought before the courts for consideration in actual litigations.

Title in Inventions. Inventions may be made by single persons or by more than one person. If made by more than one person, they are said to be joint inventions. A joint intellectual conception is a very rare thing, but it frequently happens in the actual practice of the mechanical arts that two, or even three, persons will work together simultaneously in the joint solution of a mechanical problem and will finally secure a result for which no one of the parties can say that he was wholly responsible, and which no one can divide into separate parts which can truthfully be said to have been severally contributed by any one of them.

It frequently happens that a person who has supplied money to an inventor to develop his ideas or to conduct his experiments, insists upon being joined with the inventor as a co-inventor and co-patentee. When this is done and there is no real joint invention, contributed by each of the parties, it simply renders the patent invalid, because the patent laws contemplate that the patent shall be issued to the actual inventor and if the wrong person is chosen to make the application the law has not been complied with and the patent is void.

The relations of an *employer and employee* in the exploitation of an invention, made by either one or the other, are troublesome sometimes to define and separate. The fundamental principle governing this relation is that an *invention belongs to the inventor,* and the person who has contributed assistance to the inventor either in ideas, labor or money, is not entitled to be regarded as an inventor with him merely from that fact. Frequently, however, inventors are not mechanics and are not sufficiently practical to work out the details of an invention which they have conceived. Under such circumstances, they have to call in assistance. The presumption is in such a case that the man who conceived the idea and called in help to perfect it, is the

inventor, and in order to overcome such a presumption the employee must show by the most convincing proof that he made the invention himself without suggestion or control of his employer. On the other hand, if the employer merely suggested to the employee that it would be *desirable* to accomplish a certain result, without suggesting *any means* by which the result might be accomplished, and the employee by his own intellectual methods devised such means, then the employee would be entitled to the invention and to the patent. In such case, if the invention were embodied in a machine made by the employee in the employer's time and with the employer's material, the employer would be entitled to the use of the particular embodiment of the invention so long as it lasted and would be entitled continually to repair it and keep it in proper working condition.

No employer is entitled to patents upon the inventions of his employee merely because the relation of employer and employee exists between them. The law requires that an application for a patent shall be made by the inventor, and that any transfer of interest by him shall be by way of an assignment in writing drawn in a particular form and authenticated by two witnesses or by an acknowledgment before a notary.

The Protection of an Invention. It goes without saying that the best way to protect an invention is to apply for and secure a patent upon it, but the inventor should adopt certain safeguards to protect his rights while he is perfecting the invention and before he is able to make a proper application for a patent. The government, when the patent laws were first enacted, endeavored to formulate a method of protecting inventions which had not been perfected by instituting a scheme known as a *caveat.*

A *caveat* is a document describing an incomplete invention, so far as the inventor is able to do so, filed in the Patent Office with the intention that if another person files an application for a patent on substantially the same invention within a year, the person filing the caveat shall be notified and given a limited time, consisting of several months, within which to perfect his invention. A caveat, however, confers no rights upon an inventor, and as it frequently happens that he is unable to precisely formu-

late the limits of his conception at the time when he files a caveat, the examiners in the Patent Office do not regard applications for patents on essentially the same thing but differing in detail as interfering with such caveats. It is seldom that an inventor is notified of the filing of a rival application, and the caveat scheme has utterly failed of its purpose. Such is the persistence of tradition, however, among the mechanical classes that many inventors attempt to file a caveat, and frequently thereby jeopardize their rights by not endeavoring with due diligence to perfect their invention.

Most inventors think that it is desirable to conceal what they are doing in the matter of perfecting their inventions before they make an application for a patent. Now, concealment from the general public is advisable, because if the idea is a good one it is apt to be copied by unscrupulous persons, but concealment to the point of absolute secrecy is foolish. As soon as an inventor has a clear conception of what he is seeking to accomplish and the means whereby this can be done, he should at once write out a description of his invention, accompanied by sketches or drawings, where possible, and should disclose it to at least two persons *who are competent to understand it.* Above all things he should not attempt to use his wife, sweetheart or some female relative as one of his witnesses to the existence of his invention. In many states a wife is incompetent by law to testify in favor of her husband, and in most instances such persons are incompetent by education to understand inventions which their male relatives make. If the invention is one which can be embodied in a full sized machine without prohibitive expense this should be done at once and no model should be made. The Patent Office attaches to the word "model" a peculiar technical sense, using it to indicate an assemblage of parts which illustrate an idea, but which are incapable of carrying it out. For example, the making of the parts of an ordinary single cylinder steam engine out of pasteboard would fill the Patent Office idea of a model perfectly. A model, however, never constitutes what is technically called a reduction to practice of the invention, and, therefore, its manu-

facture should be avoided, if possible, and the energies of the inventor should be directed toward making the actual thing.

If the invention is a composition of matter, it should be assembled together as quickly as possible and tested. If it is a process, the steps of the process should be carried out as quickly as possible, and the necessity for limits of temperature and similar elemental principles should be ascertained. If it is a product of manufacture, it should be made in practical commercial form as soon as possible.

The reason for these precautions is that the Patent Office and the courts regard as the first inventor and the person entitled to a patent, that person who *first reduces the invention to practice.*

Several years ago in an interference proceeding (hereafter to be described) the Patent Office held that the filing of an allowable application for a patent was equivalent to an actual reduction to practice of an invention. In the case referred to the application for a patent described a very simple engineering structure which could be readily and completely understood from mere inspection, and their decision was undoubtedly right. This doctrine has, however, been extended to include all applications for patents relating to all classes of inventions, and as inventors are imaginative, it frequently happens that they describe in their applications for patents inoperative inventions, and in the accompanying drawings illustrate devices which can by no possibility be made. But if the Patent Office fails to discover that the described inventions are inoperative, the officials will decide in favor of a person who first filed such an application for a patent as against some other inventor who later actually reduced the invention to practice in concrete form. Therefore, it is desirable for every inventor to file an application for a patent on his invention just as soon as he can possibly do so, because this takes the place in the patent law of the actual construction of a device embodying the invention, and saves the necessity of proving the existence of the invention by witnesses and the existence of models.

The *Patent Office* is a bureau of the Department of the Interior, located at Washington. It is presided over by an official

called the Commissioner of Patents, with several assistants and with a large corps of examiners, each of whom has one or more assistants to help him in his work.

It is the intention of the law that every application for a patent should be examined by one of the examining corps of the Patent Office, in order that the rights of the public may be protected and the issuance of patents comprising non-patentable things prevented.

The officials of the Patent Office are of varying degrees of competency and education, and it therefore happens frequently that patents are rejected which should be allowed, and that others are allowed which should be rejected, and consequently the issuance of a patent affords no guarantee to the inventor that it will act as a protection for his invention without effort and ligigation on his part.

The Application for a Patent. This consists of first a *petition* which is couched in a precise form prescribed by the Patent Office, and which requests that a patent be issued to the applicant, setting forth his nationality, name and address, and in very general terms the nature of the invention sought to be patented; second, of the *specification,* which is made up of two parts, namely, a *description* of the invention, which refers to illustrative drawings, where it is possible to use drawings for that purpose, and *claims.* The nature of claims will be considered hereafter. The third paper of the application is an *oath,* in which again the applicant sets forth his nationality and residence, and swears to his belief that the described invention was not known or used before his invention or discovery thereof, or patented or described in any printed publication in any country before his invention or discovery thereof or for more than two years prior to his application, or in public use or on sale in the United States for more than two years prior to his application, and that it has not been patented in any country foreign to the United States on an application filed more than a certain limited time, and that no application for a patent has been filed in any foreign country, or if filed, when, and in what countries.

These papers should be prepared with great care, and the rules of the Patent Office relating to their preparation should be followed exactly. Inventors frequently think that they can describe their inventions better than anyone else, and yet more frequently think that they can make drawings suitable to illustrate their inventions better than anyone else. Both these beliefs are usually unjustified. Drawings should be made by draftsmen skilled in doing this particular work, in order to comply with the many minor requirements of the Patent Office in this respect, and the description and claims should be prepared by a skilled attorney.

Patent Solicitors and Lawyers. In the United States it is seldom that an applicant attempts to prepare and prosecute his own application for a patent. He usually employs a patent solicitor. This is a class of persons who have learned to carry on this particular business. Down to the year 1880 most patent solicitors were persons who had had some training inside of the Patent Office as clerks or examiners, or who had had a technical training as engineers or chemists, or who had endeavored to learn the business in some other way. These persons, acting for the applicants for patents before the Patent Office under powers of attorney from the applicants, became known from that fact as patent *attorneys,* and many of them making misuse of the term "attorney" have endeavored in every way to create the impression that they are attorneys at law, such not being the case.

Since the year 1880 and the organization of the combinations of capital controlling large industries, which are commonly called trusts, the soliciting of patents for such interests before the Patent Office has usually been entrusted to lawyers who have by training in technical schools or otherwise acquired the necessary knowledge of the arts and sciences to enable them to practise before the Patent Office.

Patents are of little value until they have been made the subject of litigation in the courts to determine their scope and validity, and it is obvious that if the application for a patent has been entrusted to a competent lawyer, his familiarity with court procedure and the way in which judges decide cases, and his

ability to weigh court opinions and the like, result in far better patents than those taken out by persons without legal training.

This situation has offered an additional inducement to those who are merely patent solicitors to make a misuse of the word "attorney" as above stated. Other things being equal, patent business should, therefore, be entrusted to lawyers rather than persons who have not had a legal education.

Under the patent laws of England, from which our patent system was originally derived, the inventor in his application papers described how to practice his invention, and left it to the public who subsequently read his description to determine what the limits of the invention were and to ascertain by research what was new in it from what was old. And at first this was the procedure adopted in the United States. This led unscrupulous inventors to patent immaterial improvements in the arts and in their patents describe and thus cover many things which they had not themselves invented. This resulted in an amendment to the patent laws requiring an applicant to point out at the end of the specification plainly and distinctly *what he claimed to be new.* Consequently if a patent is examined there will be found at the end of the specification a number of short statements, called *claims,* setting forth in curious technical language a concise statement of just what the invention claimed consists of.

When an application for a patent is made before the office and is referred to an examiner, the first thing that he does is to look at the claims made. Frequently his knowledge of the arts enables him to at once refer to prior patents or publications which anticipate the claims as made, and he sends to the inventor a short statement reciting that "claim 1 is rejected on the patent to Smith," "claim 2 on the patent to Jones," and the like. Under the Patent Office rules an applicant has the right to amend his application, so long as he does not depart from the original invention, as often as he pleases, and when such a rejecting communication is received from the Patent Office the inventor or his attorney proceeds to amend the claims and narrow the invention to avoid the references made. A contest thus ensues between the Patent Office and the inventor, the inventor endeavoring to

get claims as broad as possible, and the Patent Office endeavoring to restrict them. The result of this system is that the claims of a patent constitute its most important feature, and the office of the description in the specification is in reality only to aid in the interpretation and construction of the claims.

If the official publication of the Patent Office, which is called *The Patent Office Gazette,* and which contains a selection of a limited number of claims from each patent issued, be examined, the layman will be struck with the curious language in which the claims are couched and the apparent endless repetitions of the same statements in many claims, but it will be found upon a closer examination that no two claims ever cover precisely the same subject-matter. The Patent Office allows the applicant to practically make as many claims as he pleases, and he, therefore, within the scope of the invention, endeavors to make claims which will cover immaterial variations from the subject-matter of the invention, in order to prevent infringers from adopting the principle of his invention by making changes which will not fall under the language of the claims, but which will, nevertheless, contain their elements in substance.

The following will serve as illustrations for claims covering process and machine and composition of matter and product, all developed out of the same invention, which has previously been referred to as the separation of butter fat from cream. For instance, let us suppose that an apparatus for the contemplated treatment consisted of a casing mounted upon a spindle and actuated by gearing and that the casing contained a porous lining provided with an inlet and outlet port, and that a vacuum producing pump was connected to the interior of the casing by a suitable conduit. Claims might be drawn upon the different inventions involved or developed from the fundamental idea as follows:

The claim for a process might read:

The art of making butter which consists first in separating the cream from the milk, second, placing the cream in a receptacle permeable to the liquid and impermeable to the solid constituents

thereof, and third, allowing the separation to take place out of contact with the outer air and under pressure lower than the atmospheric pressure.

The claim for the machine might read:

A machine for making butter, comprising means for separating the cream from the milk, means for removing the separated cream from the milk, means for removing the liquid from the solid constituents of the cream, the whole enclosed in a casing provided with means for creating and maintaining a vacuum therein.

The claims for the product might read as follows:

As an article of manufacture, butter consisting of unbroken globules of fat having no liquid film surrounding the same, and having a specific gravity of 1.8.

While a claim for the composition of matter within the casing might read as follows:

A composition of matter consisting of four parts by weight of milk condensed to one fourth of its original volume and deprived of its salts, and one part by weight of butter fat consisting of unbroken globules.

In the case enumerated it will be seen that in order to properly protect the invention it is necessary to take out at least four patents thereon.

With respect to the quality of their claims, patents are divided into *generic* and *specific,* and *basic* and *subsidiary* patents.

A generic patent is one the claims for which cover an entire series or family of operations, while a specific patent is one in which the claims cover one of several species of ways, methods, or means for accomplishing a general result.

A basic patent is one which covers a new art, like the art of telephoning, while a subsidiary patent is one which covers a relatively minor improvement in the art.

Inventors talk very loosely about having basic patents upon inventions, when they mean that in their opinion the claims of a particular patent are somewhat broad in their nature, but actually, a basic patent is one of the rarest things in patent practice, and usually there are only four or five basic patents issued in a generation.

The Patent Document. The terms of the patent grant are decidedly misleading in one respect, to which attention should be called. The language employed, which is written upon the cover of the patent, inside of which is placed the specification, is as follows:

"These letters patent are to grant unto John Smith, his heirs or assigns for the term of seventeen years from the first of January, 1911, the exclusive right to make, use and vend the said invention throughout the United States and the Territories thereof."

Naturally, inventors are inclined to believe that a formal document issued by the government means what it says, but it don't, as may readily be illustrated by a convincing example.

The inventor of the ordinary sewing machine invented a needle, the eye of which was at or near the point as contrasted with the former ordinary style needle in which the eye was near the shank. This new construction of needle enabled the same to be reciprocated to and from the work and to carry the thread without entanglement. When sewing machines were first made the cloth operated upon had to be held in front of the needle by the operator. Another inventor seeing this difficulty invented what is called the presser-foot, which is a small device spring-pressed down against the work to hold it in place, in combination with a little ratchet-like arrangement underneath the work called the feed-dog, to move the work forward under the presser-foot, thus obviating the necessity of the operator holding the work. Now when the second inventor applied for a patent, his means employed being entirely new, it was granted to him, and his claims covered the construction of the presser-foot and feed-

dog. Under the terms of the grant of the patent which he received, giving him the exclusive right to make, use and vend his invention throughout the United States, he naturally would think that he had the right to use the invention, including the coöperating eye-pointed needle, but the eye-pointed needle was already covered by the patent of the original inventor, so that necessarily the language of the second patent was construed to mean that he had the right to make, use and vend his invention but with the implied condition that it was "subordinate to the rights of all prior patentees concerning the subject-matter of the coöperating means necessary to make his own device operative and for which patents have been already issued."

But the second inventor could prevent the first one from using his invention, and it will readily be understood from this statement that the grant of the patent does not in terms grant a positive right to use an invention which is described in the patent, but grants him the right to *exclude others* from making, using and selling a particular improvement or thing which he himself has invented and patented, and patents ought to be expressed in that language.

Interferences. It frequently happens that two, or even more, inventors simultaneously make applications for patents upon the same invention at the same time. Under the system of classification adopted by the Patent Office such applications necessarily come under the eye of the same examiner, and when he ascertains this to be the fact the Patent Office institutes a proceeding called an *"Interference,"* in order that it may be determined who is entitled to receive the patent.

The rules governing interferences are too numerous and too technical to discuss here, but, in general, it may be said that the first applicant, other things being equal, is entitled to the patent, but he is not so entitled if a subsequent applicant actually reduced the invention to practice before the first applicant and diligently proceeded to put his invention into practice and to make an application for a patent thereon. Of two inventors who made a reduction to practice at substantially the same time the first conceiver is entitled to the patent, provided he was using

due diligence in perfecting the invention and in reducing it to practice.

When an interference has been declared the Patent Office requires each applicant to state, under oath, when he first conceived his invention, when he first disclosed it to other people, when he first made sketches and drawings, when he first reduced the invention to practice, and to what extent it has been put into practical operation. These statements are made by each party without any knowledge of the dates of the opposing party. After these statements are opened by the Patent Office and each party permitted access to the other party's papers, attempts are frequently made to amend by alleging that the dates are wrong, and that dates anticipating those of the opposing party should be substituted. This practice is not permitted by the Patent Office, and the parties are strictly held to their dates in making proof of their assertions. Consequently it is necessary in preparing such statements that great care should be taken to be very exact, and that no dates should be alleged for these different acts which cannot actually be proven.

The Utilization of a Patent. After a patent has been secured the inventor naturally desires to utilize it and make money out of it. A warning should be given against patenting inventions when the inventor does not know how he is going to dispose of them after he secures the patents. The world is usually skeptical concerning the value of a patent or of the invention which it describes, and reluctant to part with money to enable the inventor to realize a profit from his invention, and those inventions are usually most profitable which are made by persons skilled in arts in which they are actually engaged in business, and who are thus enabled to utilize their inventions and the monopolies given to them by patents covering those inventions in the perfection of products which they know how to make and sell. It is very seldom that a man makes an invention outside of an art with which he is acquainted which is of any practical value.

The *title* to a patent resides in the patentee. He can sell the patent outright by a written instrument called an assignment, in which case, of course, his interest in the matter ceases. He can

sell a part interest in the patent by an assignment, in which case he retains an interest in the invention.

All the civilized nations have patent systems, and in only a few of them does the law require an application for a patent to be made by the actual inventor, as is the case in the United States.

Assignments of patents are frequently drawn where the inventor only intends to sell his United States patent, but in which the language used constitutes a transfer of the *invention,* as well as of the *United States patent.* If such language is employed, contrary to the intent of the inventor, it gives to his assignee the right to apply for patents on the invention in any country where an assignee may do so. This is one of the pitfalls which a patentee has to look out for in disposing of a patent.

If an interest in a patent is assigned, say a fractional part, like one fourth, a curious situation results. Two patentees owning undivided interests in a patent are in law called joint owners, and each patentee owns the whole invention, so that each patentee may issue licenses or otherwise dispose of interests in the invention without paying anything to his co-owner from what he may receive from the persons to whom the interests are transferred. The only way to avoid this contingency is to recite in the instrument of assignment disposing of an undivided interest in a patent either that no subordinate right shall be granted without the consent of all of the owners, or that if such rights are granted a proportionate part of the consideration received shall be divided among the owners in proportion to their respective interests.

A common way to utilize a patent right is to license persons to use the invention within a particular territory or for a limited time, or both, upon payment of a periodical sum, usually called a royalty. Agreements of this kind are frequently profitable, and if a patentee is not himself engaged in a business to which a patent relates, he will find it wise to license anyone in the business, in order that he may secure as wide a market as possible for his invention. Licensees, however, frequently do not properly account to patentees for their doings, and they have been known to keep two sets of books, one for their own use and one for the

inspection of the patentee. Various devices to prevent such dishonest practices have been devised by patent lawyers, such as the use of adhesive stamps placed upon the products of machines, counting machines secured to the actuating shafts of patented mechanism, or the like.

EMPLOYERS' LIABILITY AND WORKMEN'S COMPENSATION

By

Edmund Dwight

It is a peculiar pleasure to speak on the subject of Employers' Liability and Workmen's Compensation to a body of men who belong, or will soon belong, to the creative class of the community. The subjects have been considered by legislatures, by commissions appointed for the purpose, by lawyers, economists and theorists; by insurance companies who underwrite the financial loss involved in the working of the principle, and by financiers whose investments are in industrial properties; but so far as I have observed in the more or less voluminous literature on the subject, it has received scant attention in either the education or the deliberations of the men who have the actual supervision of bodies of working men and who design and control the mechanical processes which they use.

The problems involved are social, or, rather, human as well as financial. In fact, they are first human and, second, financial problems. The men who can best solve them are the men in such professions as those which will be yours.

The doctrines of employers' liability and workmen's compensation are artificial and legal efforts to overcome some of the hardships, wrongs, and sufferings growing out of industrial operations.

Few men, unless they be surgeons in a hospital near the scene of any active work, realize the enormous cost in human life and limb in every step of industrial human progress. There is practically no process of manufacture or construction, from the simple making of a pair of shoes, or a hat, or the garment we wear, to the building of a bridge or the boring of a tunnel, which does not take its toll in blood.

The importance of this subject is often underestimated, but it is possible to get a vivid and realizing sense of its magnitude by

the consideration of some statistics. I had assembled some of the figures which seem pertinent as illustrations and from these figures I had drawn certain inferences. Instead of giving them to you, I will read part of an address delivered just a week ago before the League for Political Education, by John Mitchell, the labor leader and economist. Mr. Mitchell undoubtedly had access to much of the same data that I had availed myself of and his facts and some of his conclusions are nearly identical with my own. His statements are so recent that I prefer to use his own words and his views come with added force because of his known position in the field of labor. Mr. Mitchell states as follows:

"These subjects concern, in a very large way, all the people of the state and nation, although they affect more immediately the workingmen, because it is upon them that the burden falls with crushing weight, and it is they and their dependents who suffer the direct and terrible consequences of such accidents. The greatest disaster that can befall the family of a wage earner is to have the father and bread-winner carried lifeless into his home, and the shock of this calamity comes with added force when the death is due to an industrial accident, yet in our country this tragedy is enacted more than 100 times each day, more than 35,000 times each year.

"It is, of course, inconceivable that the gigantic industrial movements of the American people should be conducted without some fatalities. The industrial structure is a huge machine, hard running, and with many unguarded parts, and many of the fatalities, many of the deaths in general, are simply and solely the result of conditions beyond human control and inseparable from the ordinary course of existence. But thousands upon thousands of easily preventable accidents and fatalities occur each year, and it is from these that we should strive to get relief.

"In the United States, the number of persons killed and injured is not even officially counted, but William Hard, a well-known writer, credits the American Institute of Social Service with the statement that 536,165 workmen are killed or maimed every year in American industry, while Dr. Hoffman, statistician of the Prudential Insurance Company, has estimated the annual number of industrial accidents at approximately 2,000,000. As a matter of fact, however, the death roll of industry is longer than is evident from obtainable figures. No one can compute, of course, the number annually yielding up their lives or compelled to become a burden upon their friends or relatives or dependent upon the charity and munificence of society, who have come to their death or disability as a result of disease contracted in their occupations.

"It is a strange commentary upon our boasted American civilization that in the United States nearly three times as many persons, in proportion

to the number employed, are killed or injured in the course of their employment as in any other country of the world.

"The victories of peace have their price in dead and maimed as well as do the victories of war. If the American people could understand that more persons are killed or injured annually while following their daily occupations than were killed and wounded in any one year of the Civil War; if they could realize that more men are killed annually in the mining or in the railroad industry alone than were killed from the Continental armies in the entire eight years of the American Revolution; if they could appreciate the terrible significance of the statement of Colonel Roosevelt that 'the casualties attending upon peaceful industries exceed those which would happen under great perpetual war,' they would give their cooperation heartily and enthusiastically to the various agencies that are now striving to abolish, as far as possible, the cruelties, the losses, and the widespread miseries which are caused by the hazard of industrial pursuits.

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"As an illustration of what has been accomplished in Europe through wise legislation, and as an evidence of what could be accomplished by proper legislation in the United States, your attention is directed to the fact that, taking all the mining countries of the old world, the average annual number of industrial fatalities is only 1.45 out of 1,000 employed, whereas in the United States, the average annual number of fatalities in mines is 3.46 out of 1,000 employed; in other words, for each 10,000 men employed in the mines of European countries, fourteen are killed annually, while for each 10,000 men employed in the mines of the United States, thirty-four are killed annually."

Bear in mind that for every case of injury, there are days or weeks or months and often years of acute suffering, and multiply them by the number of injured and you can get some conception of the amount of physical suffering resulting from industrial accidents. Bear in mind that a large percentage of those who are killed and who are in a great proportion men in the prime of life, leave behind them dependent families and you can get a further idea of what industrial accidents mean in any community. Now, gentlemen, I have given you these figures and I have drawn the picture very strongly, because I want to impress that aspect of the subject on your minds in the strongest way; it is the human side of the problem. I have told you that there is also a financial side.

It is impossible to even guess at the actual loss in money which

this record of death and injury involves. As a single item of cost there was paid during the year 1910, more than $25,000,000 for liability insurance premiums in the United States alone. This sum was paid by employers of labor simply to protect themselves against the legal consequences of accidents. It is mere moiety of the actual money loss caused by industrial accidents, because, in addition to these sums, an unrecorded, but vast amount has been paid direct by the employers to their injured employees and, of course, the injured people themselves who, in a large percentage of cases, have been only compensated by a portion of their earnings, are large contributors, through their own loss of wages, to the total financial cost.

There has, of course, always been an effort on the part of the injured employee to shift the burden of the financial loss upon his employer, and this brings us to the consideration of the means which the law has given him to get reimbursement for his injuries.

Prior to 1871, the only way in which a workman injured in his employer's service, or his estate if he were killed, could recover damages, was by an action under the common law. Under the common law the judges who pass upon the issues involved in any suit are limited by the precedents which the courts have already established, and under the precedents which up to that time had been established, it was very difficult for an injured workman to get what now seems to us a just or equitable treatment of his claim for damages, because the employer was permitted in his own behalf to plead a variety of defences which constituted a bar to recovery. It was not until 1871 that any serious attempt was made, so far as general labor was concerned, to regulate the subject by statutory laws. In that year Germany passed the first Employers' Liability Act. By this Act some of the defences which under the common law the employer had been permitted to plead in his defence, were removed, and the chance of recovery by the workman was thereby increased. In 1880 England passed such an act. In this country no Employers' Liability Act was passed until 1885, when Alabama adopted an Employers' Liability Act; being followed by Massachusetts in 1887; Indiana and Colorado in 1893; Utah and Mississippi in 1896 and New York in 1902. Since then

and until the recent legislation which has been sweeping over the country, little has been done by different states in the direction of intelligent employers' liability acts. Now, as I have explained to you, an employers' liability act, simply recognizes that which the common law has from very early times recognized, that any man has the right to collect damages from any other man who has done him an injury. Such acts, however, endeavor to make the matter of the enforcement of his legal right to collect damages for an injury, one of easier accomplishment than was possible under the common law, and they hold the employer to a greater degree of responsibility than the common law did. It is an old established principle of the common law that an employer is bound to furnish his employee with a reasonably safe place in which to do his work, with proper and sufficient tools, and with competent fellow workmen. Under the common law, as originally interpreted, this was virtually his sole duty, and if thereafter through the negligence of anyone, superintendent, manager, foreman or workman, an accident occurred by which other employees than the one directly responsible for the accident were killed or injured, the employer could not be held liable, unless it could be shown in behalf of the claimant that the person responsible for the accident was incompetent.

The most important feature of all employers' liability acts is that the employer himself cannot escape liability provided the person guilty of the negligent act was in any possible sense directly representing the employer or acting in a supervising capacity. Now these acts did permit many cases to be brought to trial and many verdicts recovered against employers that would not have so resulted under the common law. But the passage of the acts did not in any degree, whatever, reduce the number of suits which were brought, or enable the injured employee to sue and economically get a reimbursement for his lost time. And going back to 1871, we find that Germany had hardly begun to work under its Employers' Liability Law before it was found to be unsatisfactory and to the disadvantage of both the employers and the employees.

Germany, as you know, is a country in which social problems

are earnestly considered and carefully studied. The German thinkers who were dealing with this problem a generation ago had reached the conclusion which some of our own legislators are now reaching, that such a system was wasteful and unsatisfactory. They recognized the fact that in all industries, accidents are inevitable and that following such accidents and in addition to the physical suffering caused by them there was not only an economic loss, but a loss which was unevenly distributed; that it was borne in a large percentage of cases by those who could least afford to stand it. Their conclusion was that if the accidents and the physical suffering following could not be prevented, at least the money loss following should be distributed so that the whole of it would not fall on the victims of the accident. They realized also that to attempt to look too closely into the cause of accident and by placing the responsibility in one place or another to shift the burden of the loss could have no good result, and in 1884 Germany swept away at one blow the whole theory of the liability of the employers for their own negligence and substituted in its stead the Compulsory Insurance Law, which, in much the same form, still stands and has been adopted by other north of Europe countries. England, which as I have told you, passed an Employers' Liability Act in 1880, gave that law a somewhat longer test, but in 1897 virtually abandoned it. It did not adopt the German Compulsory Insurance Law, but adopted what was known as a Workmen's Compensation Law, and since that time most of the countries which generally follow Germany in social legislation have adopted the German Compulsory Insurance Law, and those countries which are apt to follow England in such legislation, have adopted a Workmen's Compensation Law. The difference is this: Under the German law the employer and the employee must each pay a certain sum to an insurance company controlled by the Government and thereafter the employer has no responsibility whatever to make payments to his injured employees. They look in all such cases to the insurance company, which is in fact the Government. Workmen's compensation laws follow an entirely different principle. The employer is not bound to make any provision in advance for his employees; nor are the employees

bound to contribute to any fund for their own subsequent benefit, but the employee who is injured in his employer's service has a right, irrespective of any question of negligence, to recover from his employer a certain proportion of the wages which he has lost by reason of the accident, or if he is killed, those who are dependent upon him are entitled to a payment of a fixed sum related to his wage and earning capacity.

Now, let me again state these three systems:

Under the common law, or where only an Employers' Liability Act exists, an injured employee can recover only by a suit in which in effect he proves that his employer caused the injury. Under the compulsory insurance, or German system, the whole matter of payments for injuries to injured workmen is taken out of the hands of the employer and by arrangement made at the time of service is shifted to insurance companies which are in effect the Government. Under the workmen's compensation laws it is not necessary to prove any negligence whatever on the part of the employer, but the personal relation between employer and employee is still maintained, for in such cases the employer himself must make a specific payment to the injured employee. The only modification of this latter rule is that, under the English Workmen's Compensation Acts, the employer may by the payment of a premium to an insurance company substitute such a company for himself in the responsibility to pay compensation to the injured employees.

The history of employers' liability and workmen's compensation legislation in this country is interesting and is regrettably illustrative of the American way of treating some serious subjects as compared with the German and the English method. Probably no economist has for the past generation seriously questioned the idea that justice and humanity alike require that the cost of industrial accidents should not fall on the injured alone, and there is probably no thinking man who does not recognize that, whatever the amount which may be contributed by the employer for this purpose, it should reach the persons for whose benefit it is paid as directly as possible, and with the least reduction for the cost of securing it. While no country has achieved

an ideal system for producing this result, that has been the underlying idea of the old-world legislation on the subject.

Our own legislatures have apparently taken a different view. During the whole period that this subject has been under world-wide consideration and until very recent years, it is the unfortunate fact that the legislatures of most of the American states have been over-subject to the influence of corporations, or rather of the capitalist and employing class, and this influence has made itself felt in the repeated suppression of employers' liability bills.

New York State passed an Employers' Liability Act in 1902. New Jersey has never passed one.*

Now, you are probably all conscious of the trend in this country toward social legislation; I might almost say toward socialistic legislation. The Labor Unions have been growing in strength of recent years. Their representatives are numerous in the legislatures. Capital has been more or less under the ban and the pendulum is rapidly swinging. As it swings, the legislatures of many of our states are passing from a neglect of this subject to extreme and unreasonable activity in connection with it. The step from employers' liability laws to workmen's compensation is a natural one, but it has generally been taken with care and deliberation, and, in the case of England, with intervals of years between the steps. Our legislatures are now approaching the subject with a feverish anxiety that is in marked contrast with their former apathy. Workmen's compensation laws and other laws designed to produce a similar result are being proposed and passed in a manner that is almost sure to work wrongs almost as great as the wrongs they are intended to right.

We are, however, not as worthy of censure as the bald recitation of the facts would indicate. It is easy for a nation like England or France or Germany, whose laws affect all their citizens alike, to work out any problem and pass the necessary law. It is not easy in this country. No single state can afford to adopt a law which will have the effect of driving any industry to another state, and experience has shown how difficult it is for several dif-

*Since this lecture was delivered, New Jersey has passed a comprehensive Employers' Liability and Workmen's Compensation Act.

ferent states to agree on the same law. The Federal Government, as you all know, has no power to pass a law affecting the citizens or the industries of any particular state and, therefore, each state watches its neighbors and all its legislation is influenced by the question of the effect of a law upon its own industries. This partly accounts for the backwardness of even the important states of the Union in providing sound and humane laws on this subject. It is not, however, a complete excuse.

As an illustration of the difficulty which American states have in legislating on this subject, the State of New York passed last year a Workmen's Compensation Law, this being the first important step in that direction taken by any state. Last Friday the Court of Appeals of that state declared the law unconstitutional and it is at least rather more than probable that when the question reaches the Supreme Court of the United States, as it probably will, the decision of the Court of Appeals of New York State will be upheld.

Upon its face, this decision was a great blow to the prospect of securing reasonable workmen's compensation laws in this country. Singularly enough, however, it is doubtful whether labor leaders generally regret the decision and there is a curious side light on the whole subject in the fact that the class for whose benefit the law was designed were the least enthusiastic supporters of it in New York State during the period that the law was in force, and there again we have an illustration of the difficulty in getting suitable legislation in this country. In England and Germany and all European countries, while the employer is held to a more rigid responsibility in the matter of care for his injured workmen, there is a rigid limitation of the amount which such workmen can recover from the employer and that is an essential feature of my reasonable workmen's compensation law. It was, indeed, a feature of the New York Law, but in this country the principle is repugnant to labor. The Labor Unions and their attorneys feel that if an injured employee can recover at all, his recovery should be a large one. They feel that he should not suffer any portion of the loss, which he necessarily does under a law which gives him only fifty per cent of his lost wages. They insist that

he should have the whole of his lost wages, even though he was injured through his own carelessness. Indeed, I think that most of them go further than this and want a law that carries no limitations whatever on the amount of the recovery. They would prefer to leave this question as one to be decided by the trial jury. In other words, they would rather take a gambling chance of making an actual profit out of the circumstances of the injury than simply to be put in the possession of a sure but limited compensation. In Indiana a law has just been passed which practically recognizes this demand of labor. It is not a compensation law, but is theoretically a liability law. It still leaves the subject of compensation as one to be tested by the theory of damages, but it strips the employer of nearly every defence which he can plead in his own behalf when his injured employee sues him. It throws the burden of proof upon him, which means in effect that he is to be held guilty unless he affirmatively proves his own innocence, and it provides no limitation in the event of disabling injuries, other than that the damages shall be commensurate with the injuries sustained, which of course means that they may be anything that a jury chooses to give.

I have explained these laws at considerable length because they are the means by which the employer is held to a financial accounting and you can readily judge from my statements of them that the cost to the employer is very great. What is more important to him is that it is growing very rapidly. An employer of small means may be financially crippled as the result of an accident to his men. Even an employer on a large scale may have his year's profits seriously impaired by such a case.

Twenty-five years ago in England, and at a somewhat later date in this country, employers of labor recognized that they must find some method to distribute this loss so that it would not become unduly great in single cases and thus arose the business of employers' liability insurance. You understand that the business of insurance of any kind is due to the necessity of spreading a loss which may happen to one man over a large number of men and thus reducing the cost of all such losses to a fixed sum which may be calculated in the estimates of the cost of manufacturing

any article or undertaking any given contract. It is through the medium of the insurance company that the employer accomplishes this result. And thus each employer pays the insurance company a small premium and the insurance company pays the large losses which fall upon a small per cent of their number. The insurance, however, except under the German system, is a mere incident. It is only a means by which the employer can prosecute his business with a fixed cost for meeting his liability and compensation losses. The principle of employers' liability and workmen's compensation and the progress of legislation on those subjects would go on exactly the same if there were no insurance companies through whose medium the loss can be distributed, and the cost of doing business more accurately calculated.

In the beginning, I told you I was particularly interested to talk on this subject to men who will shortly be concerned in the actual progress of industrial work and I think that the aspect of this matter which is the most important to you is that which will directly affect your own future work. It is needless to say that, if there were no accidents in industrial operations, there would be no need for employers' liability and workmen's compensation laws. There would be no cost to the employer and there would be no insurance companies to insure against the hazards of the business. Every writer on the subject admits the inevitableness of accidents in industrial operations. Most writers concede that these accidents may be greatly reduced. I am not sure that any of them go far enough in this direction and I commend to you in your studies the constant consideration of those mechanical appliances and of those systems which will tend to safeguard the lives of the workers. There has been an enormous development of what is known in a general way as safety appliances, of one kind and another. Some employers are disposed to ignore and to minimize the benefits of appliances or methods whose sole object is to reduce the number of accidents in any occupation. Some employers are not disposed to encourage engineers, superintendents, and foremen to give careful and critical thought to methods that will save the men under them from injury, but I believe that the days of the brutal employer are passing and that

in the future much greater attention will be given to this subject than has been the case in the past. It is impossible in the time available, to refer to these matters so far as they are mechanically applied, but I cannot pass the subject without a brief reference to that side of it which is human. In my judgment, the men who can do more to prevent and avoid accidents in contracting operations than any other class are the superintendents, engineers, and foremen. The superintendent in charge of a piece of work, whose chief ambition is to make a record of accomplishment in a given time or at a minimum of expense, may make a brilliant record, but he is running a very large chance of a ruined career and of a disturbed conscience if he carries his ambition for rapid performance to a point that leads him to disregard the reasonable rules of safety for his men. The cowardly, hesitating, and foolishly cautious policy in carrying on a piece of construction work is bad, of course, and it is very rare, but the bullying, slave-driving superintendent who takes unreasonable chances is possibly, in the long run, the most unprofitable type of superintendent that his employer can have.

ACCIDENTS TO EMPLOYEES AND LIABILITY THEREFOR

By

Louis L. Babcock

Within the past decade there has been a great improvement in the conditions which surround employees in this country.

Many corporations are coming to recognize the fact that their workmen's efficiency is closely related to the welfare and happiness of not only the men, but their families as well. Many large plants now furnish instruction to their men respecting domestic economy and hygiene, and as a practical object lesson are building up model villages, school and tenement houses, and hospitals. The United States Steel Corporation has been a leader in this movement. A few years ago the idea prevailed that when a man passed out through the plant gate the employer had no further interest in him. This view no longer obtains and up-to-date plants are spending their money freely to broaden and better the lives of their operatives and to furnish them with facilities to educate their children and to surround themselves with happy homes. The same thing is equally true within the plant itself. More attention is continually being given to safety devices and to rendering safer the work which is necessarily hazardous.

Without going into the refinements of negligence law or attempting to state the almost revolutionary changes which statutes have made in the common law of the country within the last ten years, it is proposed to formulate some of the salient principles of law governing this important relation.

At the outset it should be observed that the statutes of nearly all of our states forbid the employment of children under certain specified ages, and, in a measure, restrict the hours of employment during minority after this age has been reached. The same scheme obtains in respect of women, who cannot be called upon to work beyond certain prescribed hours. For illustration: In

New York, no child under the age of fourteen years shall be employed in any factory, and no child between the ages of fourteen and sixteen shall be allowed to work without the production of an employment certificate issued by the health authorities of the locality, upon the parent's application; nor can minors under eighteen be employed after certain hours in various classes of work.

Hence, employers of labor should lose no time in familiarizing themselves with these labor laws which can always be obtained upon application to the Commissioner of Labor of the state. All of these acts are based upon the theory that public policy forbids employing people of tender age or women, except as authorized by the statutes. In other words, the state enacts that the health and welfare of its citizens require that such unauthorized employment must cease. Therefore, the courts have held in many cases, that when the employment of the servant is in violation of the statute and injury results during the employment, negligence of the employer is made out sufficient to justify sending the case to the jury; which, in most jurisdictions, is tantamount to a verdict for the plaintiff.

In many cases it is quite difficult to enforce these laws because infants desirous of securing positions misrepresent their ages. In well-run plants, it is the custom to secure an affidavit from one of the parents as to the age of the child.

In the larger plants an employment bureau is organized and a card index system kept with all the employees, by which is noted the record and qualifications of the employees and other important data. This bureau is charged with the duty of seeing to it that every person is legally employed. It would surprise many owners of plants to ascertain to what extent they are innocently violating the law and to what consequent liability they are constantly exposing themselves.

One of the duties imposed upon employers is to furnish competent employees in reasonably sufficient numbers to do the work in hand. This is a continuing duty. After the master has used reasonable care in selecting his servants, the presumption arises that their competency continues, but it is the master's duty to

exercise reasonable care in respect of them, for he is responsible for incompetency of which he has notice, either actual or constructive. In other words, he is charged with the exercise of reasonable care in the way of supervision over his employees, and this duty runs during the term of the employment. A single act of incompetency does not establish general incompetency, but repeated acts may have that effect. In any event, where the incompetency is notorious and long continued, the master will be deemed to have notice irrespective of what may be his actual personal knowledge. In well-systematized plants the employment cards show the previous history of the men; and if they are properly and accurately kept, they should show that reasonable care was taken in the selection of competent men.

It should be noted in passing, that the modern tendency of imposing heavy responsibility upon the employer for injuries to workmen, will have the effect of weeding out the young, the old and the physically incapable. The men who are not able-bodied will find it difficult to obtain employment, although they may be entirely competent to do the particular work for which they apply. This has been the effect of the Workmen's Compensation Act in England. Only time will tell whether this policy is suited to this country. It is certain that the policy of our great plants will be to limit the employment to the best men obtainable where the employer is under so stringent a rule of liability as is now advocated.

It is the master's duty to issue and promulgate rules governing the action of the servants in all undertakings which are complex or complicated; which rules, if faithfully observed, will reasonably protect the servants. This principle does not apply to every simple and ordinary employment or detail of the business, but only to the general government of employees where the duties are so diverse and complicated as to require systematic cooperation in the common business. The rules should be made for such details of the work as have proved necessary, practicable, and useful among capable business men. It is incumbent upon the employees to observe these rules, and under the common law and most statutes regulating liability, if they disobey a proper rule and are injured, there can be no recovery. Proper practice re-

quires these rules to be printed so that no misunderstanding can arise as to their meaning, force, and effect. Where employment bureaus exist, the man in charge issues to the employee when he enters the service a printed copy of the rules and takes a receipt therefor, which is thereupon filed with the man's record. The employee is charged with the duty of reading these rules and must observe them. Whenever men are employed who cannot read English, the rules must be interpreted to them and this fact is noted upon the man's card. In many plants where non-English speaking men are employed the book of rules is printed in one or more foreign tongues as required. The law exacts the same obligation with respect to every man employed and while the duty imposed is ofttimes onerous, it must be fulfilled.

The master is also charged with the duty of instructing the servant respecting any dangers not ordinarily incident to the business. In case minors or inexperienced persons are employed, the master is bound to instruct them respecting the dangers ordinarily incident to the business. But the master's duty in this regard only extends to dangers which he knows about or should apprehend in the exercise of reasonable care.

To summarize:

The master should protect his servants from injury by the exercise of that degree of care which the reasonably prudent employer of such labor exercises; and should:

1. Supervise his work and employees;
2. Furnish them with reasonably safe machinery, appliances, tools, and places to work;
3. Give proper instructions as to the methods of work and the dangers incident to it;
4. Furnish competent and sufficient employees;
5. Issue and promulgate rules for the conduct and regulation of the work.

The standard of care and diligence required is that degree of care exercised by a reasonably careful and prudent man engaged in the same business. The question of the liability of the master for an injury to his servant is tested by this rule: Did the master

conduct himself, under the circumstances, as a reasonably prudent and careful man engaged in the same business would under like circumstances?

The servant cannot recover if he has contributed to his injury by his own carelessness, although in many jurisdictions, even in the clearest cases, this has become a question of fact for a jury to decide and not one of law for the Court. The servant, in most jurisdictions, is still held to assume the risks incident to the employment which arise after the master has performed the duty he owes to the servant, but this rule has been so modified by statute that the servant's assumption of risk is usually now passed upon by a jury as a question of fact; and juries almost always answer the question in the negative.

The master cannot escape the duties he owes to his servants by delegating them to a superintendent or foreman. These duties are imposed upon and remain with the employer during the contract of hiring. It has always been the rule of the common law that a servant cannot recover for an injury occasioned solely by the negligence of a fellow servant. This principle has been largely modified by statute and the tendency of recent legislation has been to emasculate or do away with it entirely.

This is necessarily a very brief sketch of the general nature of the relationship between the employer and employee. In the discharge of the reciprocal duties of this relation, both the master and the servant are held to reasonable care and prudence. In no branch of the law are such radical changes taking place through legislative action and judicial construction and rulings. It is incumbent upon employer to take every precaution to avoid injury to his men, not only on humanitarian grounds, but also from the more selfish standpoint of his own balance sheet.

It is now proposed to state a few practical suggestions based upon a somewhat extended experience.

In every plant there should be someone charged with the specific duty of supervising the safety of the workmen. This person should be held responsible for the safety of the ways, works, and machinery, and the way the work is done, reporting direct to someone high in authority. He should make frequent inspections,

for men are careless of their own safety and are continually taking chances which are avoidable and unnecessary. This system is being rapidly adopted throughout the country by railroads and large plants. There is no reason why it should not be applied to every plant. One of our trunk line railroads recently appointed a committee to go over a division, to ascertain what could be done to improve its safety. The members of the committee were old employees and had been over this same division frequently for years. But being charged with the specific duty, in two days' time they found and reported numerous cases of structures too near the tracks and other grave dangers easily remedied. This is an illustration in point. The railroad has since made these inspections a permanent duty and has detailed employees from the enginemen, trackmen, operatives, etc., to assist in them, so that every branch of the operating force may have representation on the committee. This practice will not only save and protect human lives, but will surely engender a better spirit amongst the employees. It does not take much of a negligence case to cost $5,000 to the employer. Yet, for one half that sum every piece of dangerous machinery in the ordinary plant could be fenced; every set-screw counter-sunk; every walk around machinery fixed; every railing made permanently safe, and every live wire and track crossing properly safeguarded. In addition, a storeroom could be provided containing proper material for scaffolding, chains, lamps, lanterns, ladders, and the various appliances used in repairs. How much money has been lost in our plants by neglecting these simple precautions! More important still: How many men are dragging out a wretched existence to-day whose injuries have been caused by such neglect!

This paper will have served its purpose if it is read by a single man who will spend the energy and small amount of money necessary to abolish these purely preventable dangers in his plant.

It is not sufficient to promulgate rules. The rules must be rigorously enforced. The master must guard his men precisely as the commander of a regiment does, for men in the mass soon rely upon some superior authority to watch over them and protect them from themselves. A workman will appropriate any board

at hand to use in scaffold building without taking the time to procure the sound timber which the employer has provided for the purpose. A workman may have been familiar with the location of a set-screw on the collar of a shaft for years; but in a moment of forgetfulness will be dashed to death by getting entangled with it. He will oil machinery in motion when he could do so just as well while it was at rest. Illustrations might be multiplied indefinitely. These facts must be recognized by employers if we are to prevent the great loss of life and injury which now disgraces our industrial progress.

Some years ago the writer prepared a code of rules for one of our large plants, which has been amended, from time to time, in the light of the operating experience and considerable litigation. Many of these rules relate to a specific situation and business, so it is proposed to quote simply the general rules which are more or less applicable to any plant. It is submitted that these rules, if obeyed, will afford reasonable protection to the operatives, provided special rules are formulated governing the business of the particular plant. They will be found at the end of this paper.

It is obviously important that immediately after an accident has occurred steps should be taken to ascertain how it happened and to perpetuate the evidence, so that if a suit results or a report of it to the state is required, that the precise facts will be procurable.

In the first place, there should be an iron clad rule in every shop that the situation should remain as it is until the person charged with investigation has reached the ground. Broken parts of machines and appliances should be carefully preserved, and it is usually advisable and easy to procure a photograph of the scene of the accident. *All broken parts and appliances should be tagged for identification and safely stored.* Broken pieces of iron should be so kept as not to gather rust; and every precaution should be taken to be prepared to reproduce the situation in court as it actually existed, even after the lapse of years. There should be a camera in every plant and some operative trained in its use, if the plant has no regular photographer. All the witnesses should be immediately assembled and written statements taken, which the witnesses should sign and swear to. A statement should be

taken of every eye witness and of every person who is in a position to give information regarding conditions that existed at the time of the accident, and every report should show clearly how the accident happened and the cause of it. The investigator should avoid reporting conclusions and should incorporate as much as possible of the investigation in the signed statements of witnesses, making a memorandum of the character and trustworthiness of the witnesses and the time and place of interview.

In all the armies of the world, soldiers are taught the elements of first aid to the injured, and the non-commissioned officers of the American Army are quite proficient in the art of rendering aid to the injured. Simple text books exist which the men may read and after a few lectures they are quite well qualified to render aid to an injured person. These army men are probably inferior in intelligence to the generality of shop foremen and so by comparison there should be no insuperable difficulty in the way of having a few men in the plant equally well instructed.

The members of the bar who make a specialty of procuring negligence cases, usually take the case upon a contingent fee which ranges from 20 to 50 or 60 per cent of the recovery, irrespective of how simple the case is to try. In large cities, particularly, it is a common thing for an injured workman, who has a clear cause of action and who recovers a verdict of five thousand dollars ($5,000), to be obligated to his attorney to the extent of 60 per cent of the recovery. That money, of course, is wasted. Whatever is paid should go to the injured person without any deduction. The man should receive good surgical treatment irrespective of the question of settlement. Men respond, as a usual thing, to considerate and kind treatment and as a general thing there is little difficulty in promptly settling a case with a man for a reasonable sum provided the employer goes about it with tact and good judgment.

In no event should a man who is settled with, be promised, as a portion of the settlement, that he shall be employed for any stated interval. Such agreements almost invariably operate badly, and if their existence forms a portion of the consideration upon which the man gives his release it operates to affect the legal va-

lidity of the release in case later on it is necessary to discharge the claimant. The signing of the release, in case a settlement is effected, should be attended with considerable formality. It should be impressed upon the man that when he signs the release his cause of action is gone, and he should be told that the instrument that he is signing is not a mere receipt *but a bar to any further claim on his part.* The instrument should be under seal and the claimant should acknowledge its execution before a notary public, wherever that is possible. In the case of a foreigner, the release should be carefully interpreted to the man and the interpreter's affidavit appended, showing that this was done. Each plant should have a supply of printed releases, with the seals attached; and it has been found advantageous in many cases to have printed at the top of the release in prominent letters, the following words: *"This is a release and not a receipt for wages."*

In all cases it is well to have the claimant sign the release before witnesses, as well as to acknowledge it. In some cases, employers of labor have attempted to have the men sign a general release as one of the considerations for the contract of employment, with a view to pleading this release a bar in case of an injury. The courts have almost uniformly condemned this practice.

In all cases at all serious, it will well repay the cost to retain a competent lawyer to make the necessary investigation and to negotiate the settlement, if one results. This is especially true if the workman is killed and the heirs have to be dealt with, for special rules apply to such settlements.

This subject is too large to cover in a single lecture. It is one which, of late, has engrossed the thoughts of many of our ablest men. Politicians have found it a safe issue, for they can always improve their standing with labor by introducing drastic reform bills. The common law of negligence has been found unsuited to our present ideas and is gradually being superseded by statute. This result has been hastened by the fact that employers have not paid sufficient attention to the welfare of their men prior to an injury. It is no longer in accord with the spirit of the times, to await an injury before adopting protective devices. The writer asserts, in the light of considerable experience, involving hun-

dreds of industrial accidents, that over 50 per cent of these accidents would never have occurred had the employer exercised the same skill to avoid them that he shows in manufacturing and disposing of the product of his plant.

Appendix

General Rules

1. These rules are adopted and promulgated to insure the safety of employees of this Company. Their observance is hereby enjoined, and no one is authorized to change or amend the same or any part thereof in any respect, save by proper authority from the General Superintendent in writing.

2. Every employee must always have a copy of these rules at hand, and be conversant with every rule. He must render all the assistance in his power in carrying them out, and immediately report any violation of them to the head of his department, as hereinafter provided.

3. The fact that any person enters or remains in the service of the Company will be considered as an assurance of willingness to obey its rules. No one will be excused for the violation of any of them, even though not included in those applicable to his department.

4. All persons entering the service of this Company will be required to sign an acknowledgment that they have read, understand, and do agree to obey the rules and regulations of this Company.

5. If in doubt as to the meaning of any rule or special instruction, application must be made at once to the proper authority for an explanation. Ignorance is no excuse for neglect of duty.

6. The failure on the Company's part to enforce these rules, or any part thereof, shall not be deemed either an abrogation or an abandonment thereof.

7. By continuing in the service of the Company, each employee assumes all risk arising from either an habitual or occasional violation of any rule of the Company, either herein contained or otherwise promulgated, unless he shall report such violation in writing to his immediate foreman, who in turn shall forward the said report to the Superintendent.

8. A bulletin board will be found inside each gate. Other rules and regulations will from time to time be posted in duplicate on each of said bulletin boards. Each employee of the Company is hereby ordered to inspect one of the said bulletin boards each day, and carefully read any notice, rule or regulation posted thereon. All amendments to these rules, if any there be, will be posted thereon, and when so posted shall be as effective as though included herein.

9. Every employee is required to exercise the utmost caution to avoid injury to himself or to his fellows, and he is hereby warned that before exposing himself in working with or on the scaffolding, roofing, machinery, tools, equipment or appliances of this Company, he must examine for his own safety the condition of all scaffolding, roofing, machinery, tools, equipment or appliances or whatever he may undertake to work upon or with, before he makes use of or exposes himself on or with the same, so as to ascertain their condition and soundness.

10. *Vigilance and watchfulness insure safety. To avoid danger adopt the safe course. Employees must not trust to the care exercised by another when their own safety is involved.*

11. Every employee is required to report promptly, either to the Superintendent or his foreman, or his immediate superior officer, any defect in any scaffolding, machinery, tools, equipment or appliances of the Company affecting the safety of anyone in using or operating upon or with the same. Repairs should be requested and made at once, if necessary to be made. Employees are forbidden to use unsafe planks, appliances, timbers, gearing, ropes or machinery of any kind or description. Employees must see for themselves that repairs so requested have been made before exposing themselves.

12. A supply of sound ropes, gearing, cables, planks, appliances, timbers and tools of all kinds and sizes, are constantly kept on hand by the Company in the store houses. They may be had by application to the custodian thereof through the respective foremen. No excuse will be accepted in case of accident arising from the use of unsound or damaged material of any kind.

13. It is hereby made the duty and right of every employee to refuse to obey any order which imperils his life or limb. No person who is careless of others or of himself will be continued in the service of the Company.

14. Every case of injury to person or property must be promptly reported in writing on the accident report blank provided for that purpose to the Chief of the Safety Department, stating the names and residences of all witnesses and all particulars of the occurrence.

15. All employees will be regarded as in the line of promotion, advancement depending upon faithful discharge of their duty and capacity for increased responsibility.

16. Every employee is required to keep the place of work subject to his control in neat and cleanly condition. Disorder and dirt will be taken to indicate laziness and incompetency.

17. Employees are forbidden to leave their places of work to go to other parts of the plant during work hours, except on business of the Company.

18. Employees are forbidden to venture into dark places, whether near their place of work or not, without first obtaining a light to make their way safe. If employees violate this rule, they must assume all risk of injury.

19. The Company has in store within the grounds and within convenient access large quantities of all the safety appliances required by these rules; lamps, lanterns, torches, gearing, ropes, cables, timbers, lumber of every description and the necessary materials to construct such structures as shall be necessary to do work with safety. In case any employee shall apply to the person in authority immediately over him for any of these articles for use in the prosecution of his work, and shall meet with a refusal, it is his duty and he is hereby ordered to refrain from exposing himself to danger and forewith report the matter to the General Superintendent or his assistant, and he is authorized to refrain from obeying the order of a foreman requiring him to expose himself to the risk of an accident growing out of a failure to equip himself with the necessary appliances to do his work without risk.

20. Employees must obey all general and special rules of this Company whether such rules are contained among the rules governing their particular department or not.

21. Every employee whose duties require him to work with or upon machinery, tools or appliances of any sort or description must carefully inspect and examine same, and report in writing to his foreman or superior officer any part or portion of such machinery, tools or appliances, which is not properly guarded or in proper condition and repair, and for failure to so report he will be held to assume all risks of accident therefrom.

22. Every employee upon entering and while continuing in the service of this Company must familiarize himself with the dangers in or surrounding his place of work, and avoid them so far as is possible; and every employee by entering upon or continuing in the service of this Company shall be presumed to have assumed all risks of his occupation or employment.

23. Employees are forbidden to approach or stand too near cables or ropes under tension or strain, in order to avoid the dangers resulting from the parting or breaking of such ropes or cables under such tension.

24. Employees are forbidden to stand under hoists, cranes, conveyors, tackle, buckets or ladles while molten metals or weights are being carried, moved, raised or lowered.

25. Employees are forbidden to walk upon or along the various railroad or gantry tracks within the premises of this Company, and are forbidden to cross tracks of any description without first looking and listening, while in a place of safety for approaching cars, engines or other movable machinery. Never cross track where a full view in both directions cannot be secured. Always act on the assumption that near-by cars, en-

gines, machinery or structures on the track are apt to be suddenly moved, and avoid crossing at such places.

26. Employees are warned that it is frequently impracticable for the men operating engines upon the Company's property to give warning of their approach. Always act on the assumption that engines or cars are in close proximity and see for yourself that the crossings are safe to pass over.

27. Catching on engines or cars, crossing trains or other bodies in motion, or riding on engines, cranes, cars or other moving bodies, except when so required by your duties, is forbidden as a highly dangerous practice to life and limb. The company does not require it to be done, and positively forbids the practice.

28. Employees are forbidden to remain upon or in close proximity to any track or runway used for the passage of engines, cars, cranes, larries, material conveyors of all kinds, or machines or machinery of any sort, where there is any danger of being struck, caught or injured in any manner by the same or by the appliances attached thereto or connected therewith or by material handled upon or by the same. All tracks, tramways, skids, chutes, passageways and runways for the operation, movement and passage of machinery, engines, cars, cranes, larries, conveyors or of material in any form or of any sort, are themselves places of danger and must be avoided by the employees of this Company.

29. Whenever an employee is directed to work in close proximity to any track, tramway, skid, chute or runway used for the movement, operation or passage of an engine, car, crane, larry, conveyor, machinery or material, he must keep in mind and look out for location and movements of same, and in all other ways take the utmost precaution to avoid being hit or run over by the said engines, cars, cranes, larries, and conveyors. Before commencing work near any such track, tramway, skid, chute, runway or passageway, he must first notify the foreman of the mill, shop, yard or place where said engine, car, crane, larry or conveyor is located and must also notify the operator, engineer or machinist having physical control over the movement and operation of each engine, car, crane, larry or conveyor from which injury is possible. He is forbidden to stand or work where the engine, car, crane, larry, conveyor or material if moved can injure him, and he must at all times watch out for his own safety and observe the requirements of this rule notwithstanding the giving of such notice.

30. Whenever any employee is directed to work in, upon or in close proximity to any machine or machinery, or within or in close proximity to any pipes, wires, bins, tanks, boilers, vats, furnaces, cellars, switches or switchboards, conveyors or other conductors or receptacles for the use of steam, gas, water, electricity, ore, coal, coke, fire, heat, molten metal, acids or materials of any sort, he must first, before commencing work at, in or

near such place, notify both the foreman in charge and any employee entrusted with the duty of regulating or controlling the flow, movement or passage of such steam, gas, water, electricity, ore, coal, coke, fire, heat, molten metal, acids or materials of any sort into, within, through or out of any such place.

31. Employees are forbidden to set in motion any engine, car, crane, larry or conveyor, material or any machine or machinery without first assuring themselves by personal investigation that there are no employees or other persons in or about such engine, car, crane, larry, conveyor, material, machine or machinery, or upon or in close proximity to any track, tramway skid, chute or runway used for the passage of same, whose safety is endangered by so doing, and any employee disregarding this rule will be subject to discharge from the service of this Company.

32. Employees are forbidden to turn on gas, steam, water, electricity, fire, heat, molten metal, acids or any other dangerous substance, without first assuring themselves by personal investigation that there are no employees or other persons within, in contact with or in dangerous proximity to the pipes, wires, tanks, boilers, vats, furnaces, cellars, switches or switchboards, conveyors or other conductors or receptacles, whose safety is endangered by so doing, and any employee disregarding this rule will be subject to discharge from the service of this Company.

33. A blue flag by day and a blue lantern by night must be placed on any engine, car, crane, larry, conveyor or other machinery by the employee who is directed to or whose duty requires him to repair or work upon same, or in a position where he would be exposed to injury by the movement of the same, from any cause whatsoever. A blue signal denotes that workmen are at work upon, under or about said engine, car, crane, larry, conveyor or other machinery, and employees are forbidden to move or attempt to couple onto or to bring anything in contact with the same until said blue signal has been removed by the employee who placed it. Whenever an engine, car, crane, larry, conveyor or other machinery is protected by a blue signal, other cars, cranes or obstructions must not be placed in front of it, so that the blue signal will be obscured.

34. Employees are warned of the dangers incident to all blasting operations and to the use of explosives for excavating purposes, and are forbidden to remain in the vicinity where such work is being performed.

35. Employees are hereby warned that molten metal when brought in contact with water or cold or damp ground or other surfaces, will result in explosion, and are forbidden to permit or make such contact possible under any circumstances.

36. Employees are warned of the constant danger existing at or in the vicinity of blast furnaces, blast stoves, ore bins, ore beds, unloaders, conveyors and all other blast furnace equipment, resulting from the frequency of gas explosions, escaping gases and break-outs of molten metal

from the furnaces, slips of furnace stock causing explosions, and discharge of same from the furnaces, sliding and caving in of ore piles, dropping of ore or other material from overhead buckets and carriers. Employees are accordingly forbidden to go on top of or remain at or in the vicinity of blast furnaces or other blast furnace equipment above mentioned, unless the duties of their employment require their presence in such places, in which event they are forbidden to remain there longer than is actually required to perform their work.

37. Employees are forbidden to take short cuts over dangerous places, or to use temporary paths, planks or walks where any other path or passageway is available, which is known to be safe, even though such other path or passageway is longer or less direct.

38. Employees are forbidden to remove or disturb any covering or guard placed over any sprocket, gears, clogs, wheels, set-screws or other dangerous parts of machinery or unsafe places, except for purpose of oiling or repairing machinery, and anyone violating this rule will be dismissed from the service of this Company.

39. Employees are forbidden to go aboard boats at the Company's docks, except when their duties require them to do so.

40. Employees are forbidden to rest upon or lean against any railings or guards built upon or alongside of dangerous places or machinery.

41. Employees are forbidden to stand or pass close to cars which are being loaded at the pig iron machines, or any places where chipping work is being performed, in order to avoid danger from flying pieces or particles of metal or other materials where such work is being done.

42. To avoid accidents employees are required to use steel cable or wire rope instead of hemp rope for slings supporting pulleys, block and tackle and all other hoisting apparatus.

43. In using all hoisting apparatus, employees are forbidden to make a hoist before the load is securely made fast and properly balanced to insure safety.

44. Employees engaged in dumping ladles of molten metal, dust, or cinders must use care not to stand in the way of any metal or cinder which might splash or run out of the course in which it is intended to flow, and must first see that it will not run in the direction of the point where they are standing.

45. Employees are warned against crossing over conveying tables or runways while mills are running. They are liable to be struck by the hot bars which are being rolled.

46. Employees are forbidden to light furnaces, except with a wood fire. They must not turn on gas until a good wood fire is burning.

47. Employees are forbidden to use a pole or stake in moving engines, cars, cranes or other conveyors located on adjoining tracks.

48. Employees are forbidden to place set-screws in shafts, collars or

other movable machinery, allowing head of screw to project out any distance without proper protection of the projecting screw head. No excuse will be accepted from anyone leaving set-screws projecting and unprotected, and anyone doing so will be immediately discharged.

The foregoing rules are of general application. The special departments should be governed by rules applicable to them. The following rules are given as illustrations:

Electrical Department

1. Employees are forbidden to go upon or to remain upon any overhead crane, hoist or other overhead appliance, for any purpose whatsoever, without first giving notice to the foreman in charge of such crane, hoist or other appliance of his intended presence there.

2. A red flag has been supplied for the cage of each crane, which must be conspicuously displayed in the socket hole provided for that purpose whenever the crane operator leaves his post to work around or in proximity to said crane for any purpose. Such flag shall be a notice and warning to all persons that the crane *must not be moved.*

3. Employees are warned not to come in contact with switches, controllers or fuseblocks in such manner as to produce a short circuit through themselves, and must assume all risks of injury resulting from disobedience of this rule.

4. Linemen are forbidden to work on poles or other high places without the use of safety belts.

5. Before working on any electrical apparatus or close to any wires, cables or other conductors of electricity, employees must first make sure that all such apparatus, wires, etc., are properly insulated.

Foundry Work

1. Employees are forbidden to place water, snow or ice in any ladle, pot or other receptacle intended for the use of molten metal, or to allow moisture in any form to accumulate therein, and are forbidden to jostle fellow-employees while carrying or working with molten metal; and employees are further forbidden to pour or spill molten metal upon any cold, damp or rusty surface and must assume the consequences of all explosions resulting from the violation of this rule.

2. Employees are forbidden to wear laced or buttoned shoes while engaged in or about the foundry, but must provide themselves with shoes that can be easily removed in case of emergency to prevent burning by molten metal.

Construction and Excavation Work

1. In case it becomes necessary to excavate or pile material, earth or other substances near a passageway, employees must see that they are protected by lights and barriers at night and barriers all day, so that no one may fall into, against or over same.

2. Employees are required to use great precaution in excavating, shoveling, picking or digging in all places where dynamite or other explosives have been used for blasting purposes, and avoid striking with their tools or appliances unexploded charges or portions thereof. They must carefully examine and inspect all such places before and while continuing work at or near the same, and by their failure to observe this rule shall be presumed to have assumed the risks resulting from striking and exploding such charges.

3. Employees are instructed and warned to remain at a safe distance for a reasonable length of time after an attempt to blast has been made before returning to such places or its immediate vicinity, and by their failure to observe this rule shall be presumed to have assumed all risks from subsequent or delayed explosions.

4. All excavations must be shored up to protect those working therein, and each man must see for himself that this rule has been complied with.

Scaffolds and Scaffolding

1. The Company has on hand for use at all times a sufficient quantity of new and sound ropes, slings, timber and scaffolding appliances of every description, proper and fit for use.

2. Every employee before going upon any scaffold of any description, must see for himself that the scaffold and its supports are properly built and erected of good and sound material and properly secured to its supports, or if a hanging scaffold, to the structure against which it is suspended. Sufficient time will be at all times allotted to each employee to make this examination. He is forbidden to enter upon any scaffold of any description until he has satisfied himself by such personal examination that it is safe to support four times the weight which the prosecution of the work at hand requires. Employees are forbidden to trust anyone else to see that such scaffolding is safe and sound. Every employee who goes upon a scaffold without first carefully inspecting it and seeing that it is safe or made safe will be discharged.

3. Upon entering upon the scaffold employees are notified that they waive any provisions of law enacted for their protection in the event the scaffold fails in any respect, causing injury. Employees must not trust to the care exercised by another when their own safety is involved.

GATHERING ENGINEERING COST DATA*

By

Halbert P. Gillette

I purpose offering a few suggestions on the methods of securing and using cost data. I need not dwell long upon the use of such data; the difficulty consists in the finding of the data rather than in the application of them when found.

The dearth of information bearing upon the actual cost of doing work will soon become apparent to many of you, if my own early experience in any degree typifies that of the average engineering graduate. I recall with distinctness the day when a farmer entered my office and asked for "the surveyor." Being informed that I was "the surveyor," his next question was, "What will you charge to subdivide a section of land for me?" I put the question to you, gentlemen—What would you charge to subdivide a section of land? You are doubtless quite as capable of answering now as I was then. After some "sparring," in which I asked the location of the land, the density of brush, and the like, I made a guess, naming $20 as the fee for the work. I remembered afterward that my farmer friend closed the bargain with alacrity. I, with my party (of one man), spent just six days chopping brush, not to mention two days finding lost corners, so that when the center of the section had been located, I turned over the $20 to my party for wages, and, as for myself, I had left the cost data. Few of you are likely to have just such an experience, but many of you will have experiences not so greatly dissimilar.

The lawyer and the doctor are not expected to submit their bills until their work is done. The engineer, however, because he is a master of exact science, is presumed to be gifted with exact foresight even as to bills for his own services. So you need not be surprised if some prospective client, who contemplates

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building a trolley line, asks you what the survey will cost, and takes out his note-book to record the reply before you can catch your breath.

Fortunately, there is a good deal in print relative to the cost of different kinds of surveying, but unfortunately, and strangely enough, these surveying cost data are not ordinarily to be found where you would most expect to find them, namely, in text-books on surveying. In view of this condition of affairs, I advise you to record in a note-book every bit of information that you can secure relative to the cost of surveying; and I would go farther in advising you to record the time that you yourselves take to do the various pieces of field work at the summer schools of surveying. This you should do not so much for the few cost data that you will obtain while making these practice surveys, but for the habit that you will thus form—the habit of observing and recording the time consumed in doing work. Let me pause here to say that for the formation of a habit that has been invaluable to me, I am indebted to Professor Monroe; for, as a part of our summer school of mining work, we were required to record in note-books not only the methods of drilling, and the like, but the progress made—the cost of doing the work. The data that I thus gathered were not without value, but the habit that I thus formed has been to me invaluable.

Shortly after my first experience in the art of cost guessing I was called upon to locate a number of wagon roads through a new country, hilly and covered with dense forest. Having finished the survey and computation of quantities for a gravel and plank road some eight miles long, I submitted my plans and estimate of quantities. I was requested to submit also an estimate of the cost of each item of work. "What will it cost?"—the same old question again! Going to my office, I turned instinctively to the book that I had always supposed contained all that was known about the cost of engineering work. The first item that I had to consider was earth excavation, and I felt that on this item I should not be disappointed in putting my trust in the book. I found that, for the short haul in the road work under consideration, drag scrapers would be most economic; and, if my memory serves me

right, I learned that about five cents per cubic yard would cover the cost of my road excavation. But when I stopped to consider it, that seemed a very low unit cost, and I recalled vaguely having seen contract prices for road work that were much higher. However, I reasoned that the conditions governing my work probably differed from those governing other work, and surely I could not err very badly in accepting the data furnished by my book. Fortunately, my mind was not wholly at ease in spite of the book's elaborate tables of earth-work cost, and I finally resolved to find some local contractor and put the question to him as to what he would consider a fair price for earth excavation under the given conditions. I found my man, a Mr. Murphy I believe his name was. Mr. Murphy, after hearing my question, did not turn to his book, as I half hoped, half expected he would, but without hesitation gave some twenty odd cents per yard as being a fair price for the work. In spite of the fact that he seemed very sure about it, I ventured to remark that Murphy and my book did not agree very closely. I was told in a few forceful terms that tables of earth-work cost had been "the ruination of" more contractors than Mr. Murphy had fingers and toes. I was informed that a book was "very good for the theory," but worse than useless for "the practice."

I may say here that, for fear of betraying your ignorance of costs, you need never hesitate to go to a contractor for information. I find that contractors, as a class, think that engineers, as a class, know next to nothing about the actual cost of work, and I fear that there has been altogether too much reason back of this belief. An older man is always flattered by having a younger man come to him for advice or for information, and contractors are no exception to this rule.

There is, however, another side to the reliability of this source of information. Contractors often err exceedingly in their estimates; and an experienced contractor is more likely to err than an experienced engineer where the work is new to both, the reason being that the engineer, by virtue of his mathematical training, is more likely to "figure out" every item rather than to "lump off" the unknown in one bold guess.

Reverting to my estimate, or perhaps I should more truly say to Mr. Murphy's estimate, of the road work, I was taught by it a very useful lesson, and incidentally the habit of keeping records of the cost of work coming under my observation was strengthened by this experience. I have since found that records gathered thus at someone else's expense are not the least valuable of an engineer's stock in trade.

There will come a time when some of you will be "out of a job" (at least that has been one of the experiences of a few of us who are older in the profession), but even then you may usually spend your time to good advantage if you are near the site of construction work. Let us assume, for example, that Fifth Avenue is being paved with asphalt, and that you have a little time at your disposal each day. In the morning you visit the work, count the men engaged, and observe their respective duties, all of which you enter on a scrap of paper to be afterwards copied into your permanent note-book. You talk with the foreman and learn from him what the average progress of the work has been, but under no circumstances do you rely entirely upon what he tells you. You note that the pavement has reached a point opposite No. 531, at a given hour, and then you go away to study some other work in the same way. Later in the day, or the day following, you return and pace the distance progressed since your previous visit when the end of the pavement was opposite No. 531. Thus you find out whether or not the foreman was somewhat of a liar, as occasionally happens. But the foremen are not necessarily liars even when they deceive you, for it often happens that they themselves do not know the average rate of progress. Foremen on pavement work usually do know what a fair day's work is, but on work less easily measured, they frequently do not. You may now watch the gang laying the concrete pavement base for an hour, counting the batches and estimating the yardage; and upon comparing this short-time observation with your record for the full day, you may learn something else—something about human nature. Should the output of the laborers for the hour's work exceed the rate for the full day by 50 per cent, or even 100 per cent, do not regard the short-time observations as valueless. Look

about. The contractor himself may be standing near by. The presence of the man who pays the men out of his own pocket often has a magic effect. Where laborers were averaging 12 cubic yards per day loaded with shovels, and where they were apparently working well, I have seen the output jump to 18 cubic yards and maintained day in and day out at that rate, simply because of a change in management.

Let me digress here to say a word about foremen. When a foreman comes to you seeking a position and mentions as one of his qualifications the fact that he is always popular with laborers, and that as a consequence they will do more work for him than for other men—don't take any stock in that foreman. Men, as they are now constituted, do not work for the pleasure of pleasing a foreman. The "jollier" is good enough in his place, but his place is not as foreman of a gang of laborers. The same severity of discipline should be maintained as in the army. The foremen, who are in reality the officers, should keep aloof from the laborers socially, and should hold the men strictly to their tasks with little or no show of leniency. If you will choose extremes, choose the swearing foreman in preference to the "jollying" foreman. Advice of this kind sounds harsh, and so it is, but work is a harsh task for most of us in this world, and it takes harsh measures, often harsh language, to hold us to our duty.

I shall speak next of an experience in estimating the cost of bridge building. I designed two highway bridges of a modified Howe truss type, and, forming a partnership with an experienced bridge foreman, went about securing a contract. Of course it was not difficult to estimate the cost of the timber and steel delivered at the sites, but when my partner and I put our heads together in an endeavor to agree upon an estimate of the probable cost of the labor of framing and erecting the bridges, our heads did not bump. Indeed we were about "100 per cent apart," as someone put it. My partner guessed that $500 would cover the labor item on one bridge—a bridge with a 16-foot roadway, 160 foot span, designed to carry 100 pounds per square foot. I had all the books on bridge design and construction, but diligent search had failed to disclose a single scrap of information that would guide me in esti-

mating the cost of building a Howe truss bridge, or, in fact, a wooden bridge of any sort. I turned to the files of the only engineering journal available, and finally I found just one little half-column article giving some costs for a Howe truss railway bridge reinforced with the wooden arches that were common in the early days of bridge building in this country. From the data there given, I estimated the labor on one of my bridges at $1,000 or 100 per cent more than my partner's guess. We "split the difference" (a process not infrequently used by engineers and contractors) and we bid accordingly. The first bridge erected by us cost almost exactly $500 for labor plus $500 for materials. I think this is as good a record for economic bridge construction as is likely to be found. I feel safe in making the assertion, for, although that bridge was built eight years ago, I have yet to find any published record of the cost of Howe truss bridge building other than the one that I mentioned a few moments ago. I shall not now give the itemized cost of this work, for my present purpose is not to give you data so much as to indicate how scarce data are and how desirable it is to form the habit of gathering and analyzing them.

Our next bridge went the way of many a good bridge over many a turbulent Western river. A freshet undermined the falsework, and let the bridge drop the day before its expected completion. When we had fished what was left of our bridge out of the water, when we had put it up again, and when we had settled the hospital bills (by a miracle there were no deaths) my original $1,000 estimate was exceeded. I learned by this accident two things: (1) Never to omit an allowance for accidents and other unforeseen contingencies; (2) never to neglect to insure the workmen. I shall digress to say a word about insuring laborers. Up to that time, I had supposed that if laborers were to be insured, it could of course be done by taking out a separate accident policy for each man—quite an expensive procedure as you doubtless know. After the accident I learned upon looking into the matter that a blanket policy covering all the men can be taken out, and that the premium is a given percentage of the pay roll; thus on earth-work you may insure all your men for less than one per cent

of the pay roll. This insurance does not give to each man a weekly stipend in case of accident, or to his heirs a designated sum in case of death. What the insurance company does do is to protect the contractor by assuming all liabilities from claims made by injured workmen or their heirs. The insurance company limits its liability, however, so that in case a number of men are killed by one accident, the contractor may have to stand part of the damages. No matter how safe the work seems to be, a contractor should never neglect to take out a pay roll insurance policy. Many a contractor, just starting in business, has been ruined through failure to insure against accident.

Taking up again the subject of cost gathering, I would impress upon you that you should not wait until you are in responsible charge of work before you begin gathering cost statistics. Many of you will find yourselves before long in the position of inspector on some engineering work of magnitude, and the very magnitude of the work will probably discourage you in your determination to learn something about costs by your own observation. Let me assure you that you need not be in the least discouraged, that in fact you will probably be in a better position to acquire the most valuable kind of data than is the chief engineer himself. He, to be sure, will learn in a general way what each of the classes of work costs; but you, if you avail yourself of your opportunity, will learn in detail what certain parts of the work cost. I would sooner know every detail of the cost of a given kind of work on the New York subway, for example, than to know in a general way what all the items cost, and let me explain to you why. Suppose that you determine to learn the cost of rock excavation where cableways are used to handle the excavated rock. You start by studying the cost of handling the rock with the cableway, and with your watch in hand, you note that at 9 : 15 : 10 (reading the hour, the minute and the second hand) the bucket begins to rise from the pit; at 9 : 15 : 20 it is out of the pit and begins its travel along the cable; at 9 : 15 : 40 it has reached the dump; at 9 : 15 : 55 it has dumped; and so on until it has made the round trip. Thus you time in detail a large number of round trips until you have a fair average for each element.

You measure the lift and the distance of travel, and you note the kind and size of engine used; and when the plant is shifted from one place to the next you ascertain the lost time and the cost of shifting. What, you may ask, is the use of going so minutely into details? The answer is simply this, that you may be able to predict the cost of future work where some of the details differ, as for example the lift, or the length of the haul, or the number of times the plant must be shifted for a given yardage of excavation. Without such detailed data you will be unable to predict accurately but will have to guess. It is just this kind of detailed information that the chief engineer very likely will not get, so that, in fact, with all his seeming advantage he may not be able to predict the cost of similar work, where conditions vary somewhat, with as great accuracy as you can. Indeed, I venture to say that on one job, thoroughly studied in detail, it is possible for a young engineer to learn more about actual costs than the majority of engineers learn in a lifetime.

Let me cite an example to emphasize the importance of a detailed knowledge of rock excavation. An engineer, a man of middle age who had seen a great deal of construction work, determined to bid upon one of the sections of the Erie Canal deepening work in 1896. He secured a contract at prices almost the same as those that had prevailed on the Chicago Main Drainage Canal, that is, 75 cents a cubic yard for rock excavation and 28 cents for earth. To this engineer all canals evidently "looked alike." Canals, to him, were canals, and rock was rock; he gave no heed to the fact that on the Chicago Canal the rock was taken out in three benches, each twelve feet thick, whereas in the Erie Canal deepening one bench only two feet thick had to be removed. To this day I cannot account for that engineer's failure to make at least some allowance for the difference in conditions, but he did not, bidding for the rock about half the price received by other contractors. Of course, when he began to do the work and found how much of the time his cableways were idle during the frequent shifting necessitated by the shallow cut, when he found what an amount of drilling per cubic yard is necessary where the face is only two feet, and when he found that he had a great quantity of

snow and water to handle for a few cubic yards of excavation, he learned that there is something besides words and names and bidding prices to be known by the contractor who would escape failure.

I am led by the foregoing example to add something concerning the use of bidding prices as a guide in estimating the cost of work. I think I may safely say that 90 per cent of the engineers in practice base their estimates upon contractor's bids on a similar work. Where the rates of wages, the prices of materials and all the conditions governing the work are practically alike, this practice is a safe one; still I think that the practice is accountable for many of the failures of engineers who have attempted to go into the business of contracting. It is, on the whole, a practice not to be encouraged; but as we must all fall back upon it at times, I shall point out a few pitfalls to be avoided. Contractors very frequently unbalance their bids; by this is meant that they bid an unreasonably high price on one or more items and offset it by bidding unreasonably low on one or more of the remaining items. To illustrate, suppose 20 cents per cubic yard is a fair price for earth excavation and that $1.50 is a fair price for rock excavation, then we might have a balanced bid like this:

10,000 cu. yds. earth at 20 cts.,	$2,000
200 cu. yds. rock at $1.50,	300
Total,	$2,300

Now suppose the contractor decides for one reason or another to unbalance his bid, and bids thus:

10,000 cu. yds. at 17 cts.,	$1,700
200 cu. yds. at $3,	600
Total,	$2,300

You will observe that his total bid is unchanged; yet in case it happens that far more than 200 cubic yards of rock is encountered, he stands a chance of making a large and unjust profit by virtue of his lack of virtue, and because of his gift of foresight or shrewdness. There are many reasons for unbalancing

bids, and some of them betoken no dishonesty at all; thus a contractor may wish not to disclose to his competitors what he regards as a fair price for a certain item, because he may intend bidding at any other time when that item will be the most important on the bidding sheet. I have known a few instances where dishonest contractors have unbalanced their bids, bidding high on the items of work they intend to perform first. Then, after skimming the cream, they have skipped out for South America, leaving their bondsmen or others to finish the work at a loss. This, however, is a very rare procedure nowadays.

You will see the necessity of having a record of contract prices not on one but on a number of different contracts, so that you may strike a fair average. I have found that the most convenient way of recording bids is to copy them from the lists given in the engineering journals, using an indexed note-book. Under "Earth" I enter bids (high, low and average) for a few of the reservoirs let each year in different parts of the United States; I likewise record bids for sewer trenching, for railway earth-work, for road earth-work, etc. And in this way, I keep also an up to date record of prices on concrete, masonry, piling, rock excavation, tunnels, etc. A section headed miscellaneous is one that I oftenest consult. There I enter the prices for sodding, clearing and grubbing, fencing, etc. You will have more luck than I have had if you find any printed information as to the actual cost of sodding, for example, and the same may be said of many another item. Contract prices are in such cases your only guide, and by all odds better than a guess; but if you were to trust to your memory or to an index to find them when you needed them, you would find your memory of little service and the ordinary indexes scarcely better.

I keep three sets of cost data note-books. In one book, as I have just said, I enter contract prices; in another, I enter abstracts of actual cost of work given in published articles; and in the third book, I enter my own observations. I have done this now for some ten or more years, and I have never regretted the labor so spent. After all it takes but a small fraction of a day to keep the records up, when a system has once been worked out. Up to the present, there has been comparatively little published on the

actual cost of engineering structures all told; and it is a curious fact that most of that which has been published relates to unusual or to difficult work. Thus I could refer you to a score of articles on the methods and cost of laying subaqueous water pipe for every single article on ordinary water pipe laying on land. I could give you references to forty different articles on the cost of tunnelling in rock, as published in one engineering journal, while during the same period of time that journal has not published one comprehensive article on open cut rock excavation or railroad work, and only one on rock trenching.

As to using cost data I need say but little. In making an estimate be liberal. Contingencies are almost certain to arise that you have not definitely foreseen. Storms, strikes, delays in getting materials, errors of judgment as to materials to be encountered, or some others of a hundred and one things may act to increase the cost of the work. Therefore, I say, be liberal in your estimates. To add 5 or 10 or 15 per cent for profit is seldom enough where much labor is involved; generally 20 or 25 per cent makes a fair allowance for profits. One often hears it said that an over-estimate indicates as much ignorance as an under-estimate. Possibly it does, but I shall always prefer to be on the "over-estimate" side. I have yet to hear a man complain because he had been called upon to pay less than he had expected to pay; but I do recall some very loud protests where the final bill exceeded the original estimate. So it is with companies, and with the public. They are more apt to regard the difference between your estimate and the actual cost as so much saved by your ability, rather than as so much erred in your estimate.

In closing, I would say that had this lecture been a written one I should have gained in conciseness, and I should have been enabled to present a larger number of facts; but after all, in an hour's time I could have given only a few data and they would have been so dry as to be speedily forgotten. My principal object has been not to furnish you with data, but to assist you in forming the habit of collecting and analyzing cost data for yourselves. Perhaps a rather informal talk, illustrated with some personal examples, may have been more effective in attaining this end than

a more formal lecture would have been in driving home the fact —that it pays to observe, to record, and to analyze costs; whether you are in civil or in mining engineering, as employees, or are yourselves employers.

TASK AND BONUS IN MANAGEMENT

By

H. L. Gantt

Last year I had the pleasure of talking to the Senior class on the general subject of *Task and Bonus in Management,* and gave them some general illustrations. This time I am going to describe in detail the results in a simple case. In taking a simple case, however, I wish it to be understood that my object is to explain our methods in their simplest forms. The same methods have been repeatedly applied with practically the same measure of success to a great variety of work, and the writer has not yet encountered any work whatever which has not been benefited by their application.

In a few words, our method is this: Study your problem thoroughly, and, having decided on a course of action, make it to the interest of all your intelligent and capable workers to coöperate with you.

Performing a Task.

People as a rule prefer to work at the speed and in the manner to which they have been accustomed, but are usually willing to work at any reasonable speed and in any reasonable manner, provided there is a sufficient inducement offered them for so doing, and they are so trained as to be able to earn the reward.

In our system of management, we determine the amount of work a good man, fitted for the work, should do, and set that as the minimum acceptable task, paying for its accomplishment a substantial bonus in addition to his day's pay. We try to find, if possible, men who are already skilled in the work, and who can perform the task. It frequently happens, however, that the number of such men is insufficient for our purpose, and it takes time to train the unskilled to a proper degree of efficiency; but with a bonus as an incentive, and a proper instructor, a very fair propor-

tion of the unskilled finally succeed in performing a task that was at first entirely beyond them.

In selecting men to train for a job, care must be exercised to select only such as are physically fitted for the work, and who have ambition and energy. When an unskilled workman has been trained to do one job well, he will learn the next better job much more readily than he did the first, and after a time will feel that he is not necessarily and hopelessly in the class of unskilled labor, because he happened not to have had the chance to learn a trade, but will begin to realize that he can, in a measure at least, make up for the deficiency.

The amount of work an ordinary untrained laborer does in a day, when paid by the day, and working as he prefers, is almost never more than one-third of what a good man, fitted for the job and properly directed, could do, and is usually much less. In such a simple case as shoveling coal, a skilled shoveler will shovel forty-five to fifty tons per day, while the ordinary laborer working for day's pay, and without any special direction, will shovel only from twelve to fifteen tons.

A skilled worker, doing from two to four times as much work as the unskilled, forms better habits of work, and loses less time by absence from work than the unskilled. It is a noticeable fact that as the unskilled become more skillful and regular in their work, their health and general appearance distinctly improve. This has been particularly noticeable in the case of women. We set tasks which require them to do about three times as much as they had been in the habit of doing, and which was about 75 per cent of their maximum, and they invariably improved in health. This improvement in health seems to be due to a more regular and active life, combined with a greater interest in their work. *It is a well-known fact that work in which we are interested, and which holds our attention, without any effort on our part, tires us much less than that we have to force ourselves to do.* The task with reward for its accomplishment produces this interest and holds the attention, with the invariable results of *more work, better work,* and *better satisfied workers.* When people get in the habit of working at high speed, they much prefer it. Just as

the man who has been trained to walk at the rate of four miles per hour gets accustomed to it, and prefers to walk fast rather than to walk slow. *Working fast* or *working slow* is simply a habit, and if you can train a person to do things quickly, he will get into the habit of doing three times as much work with substantially the same amount of effort and with no greater fatigue.

MANUFACTURING PILLOW-CASES.

I am going to tell you about the application of our methods to a room where girls were running sewing-machines, and making sheets and pillow-cases. This was a very simple proposition, and as such is a good illustration of our methods in their most elementary form. It is interesting to know that there was a general opinion that the work in this room was being done economically, for everybody seemed to be, and undoubtedly was, very busy. I felt a little discouraged, and told the proprietor in a few days that it did not look as if there was much profit in the work. In order to make any improvement, it was necessary to find out in detail:

First: What the various operations of making a pillow-case or sheet consisted of, and how these operations were being performed; in other words, to become familiar with the state of the art as it existed in that room.

Second: To cut out any unnecessary operations, and to shorten the route traveled by each piece.

Third: To develop the best way of performing each operation.

Fourth: To set a proper task for each operation, and to offer a suitable bonus for its performance.

Fifth: To train the girls to perform their tasks properly.

In doing this work, I had the hearty coöperation and active assistance of Mr. T. W. Buscher, under whose superintendence this room came, and who for several years has worked with me. His assistance was very valuable in the first, second, and third parts of my work. The detail study was nearly all done by my assistant, Mr. T. P. Gates, who made the time studies, set the tasks, and trained the girls to perform them.

For the sake of simplicity, I shall confine myself to a description of making pillow-cases.

The *first step* was to analyze the work into the following necessary operations in the order given:

1. Tearing the cloth into proper lengths;
2. Sewing up the side;
3. Sewing up the end;
4. Turning inside out (inspecting);
5. Hemming;
6. Sprinkling and (inspecting);
7. Mangling or ironing;
8. (Inspecting) and folding;
9. Ticketing;
10. Ribboning and bundling;
11. Packing;

and to learn thoroughly these operations. (Those in brackets were not done very systematically until the *Task and Bonus* System was established.)

The *second step* was to rearrange the machines and the benches, so that successive operations could be performed with the least amount of transportation.

The *third step* was to develop the best and quickest way to perform each operation, and to have the work properly inspected and checked.

The *fourth step* was to study in detail the time needed to perform each operation, and to remove all obstacles so that the work could be repeated day after day, in the time set.

The *fifth step* was to teach the girls to perform their tasks regularly.

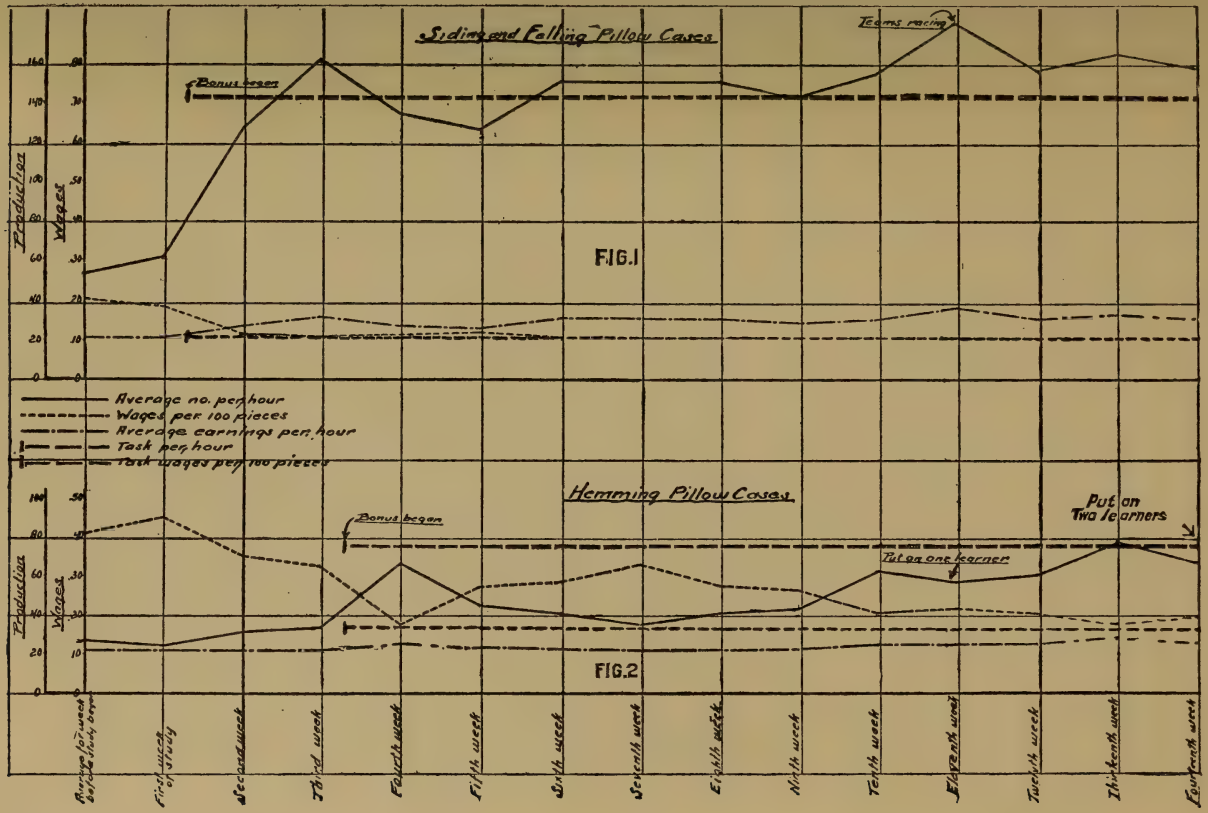
I have written the above descriptions as if each successive step was taken with all the operations at once. In reality, the process was much slower than that, and our real method was to take one or two operations at a time, and study them carefully, applying all the steps to them, and getting them on a permanent basis before leaving them.

SIDING AND FELLING.

To begin with, we selected those operations which were most congested, and which were delaying the work most. These were No. 2 and No. 3 (technically known as *Siding and Felling*). The machines on which these operations were done were placed one ahead of the other, and the work was done *tandem* in the following manner: The first girl took the top pillow-case from a pile, sewed up the side, and pushed it on to a slide, which took it to the next girl, who sewed up the end and dropped it into a box beyond her machine. A third girl turned it inside out, inspected it, straightened it, and placed it on a truck.

A careful study revealed the fact that, whereas the average number of pieces per hour sided and felled by a team of two girls during the week before we began our study was fifty-three, we were able to set a task of 142 per hour. The reward for the performance of this task is pay for the time allowed plus 20 per cent of that time. If the task is not accomplished the worker gets simply her day's pay.

With this reward in sight, and with careful training and watching two teams soon learned to earn their bonus every day. Fig. 1 shows the increase in output per hour, the increase of wages when the bonus was earned, and the reduction of wages per one hundred pieces.


Siding and Felling Pillow Cases
Teams racing
Bonus began
Production
Wages
FIG.1
Average no. per hour
Wages per 100 pieces
Average earnings per hour
Task per hour
Task wages per 100 pieces
Hemming Pillow Cases
Bonus began
Put on one learner
Put on Two learners
FIG.2
Average for week before study began
First week of study
Second week
Third week
Fourth week
Fifth week
Sixth week
Seventh week
Eighth week
Ninth week
Tenth week
Eleventh week
Twelfth week
Thirteenth week
Fourteenth week

The upper horizontal line represents the number per hour that must be done to get *any bonus,* the lower horizontal line represents wages per one hundred pieces when the bonus is earned. This being constant, the pay, when the bonus is earned, amounts to a piece rate. Our method of payment then is *piece-work* for the skilled, and day-work for the unskilled, it being constantly borne in mind that if there is only work enough for a few, it will always be given to the skilled. This acts as a powerful stimulus to the unskilled, and all that have any ambition at all try to get into the *Bonus Class.* This cannot be too clearly borne in mind, for we have here all the advantages of day-work combined with those of piece-work, without the disadvantage of either, for the day-worker who has no ambition to become a bonus-worker usually of his own accord seeks work elsewhere, and our working force soon becomes composed of *bonus-workers,* and day-workers who are trying to become *bonus-workers.* When twenty-five per cent of the workers in a plant are *bonus-workers,* they, with those who are striving to get into their class, control the sentiment, and a strong spirit of coöperation develops.

The inspector who turns the pillow-cases inside out must throw back to the girl responsible any piece defective in the sewing and put to one side any piece defective in material. If she handles all the work done by a team, and passes no bad work, she gets a fixed bonus of twenty cents per day. If she fails to do all the work, or passes a single piece of bad work, she gets no bonus. As soon as the siding and felling got to going, *on bonus,* the hemming, which is the next operation, became congested, and had to be speeded up.

HEMMING.

A study was made of this, and a task of seventy-four pieces per hour set compared to a previous record of twenty-eight per hour (see Fig. 2). Only one girl out of the four was found able to perform the task at first, and she was taken sick a few days after the task work began, and was out several days, so the production line fell sharply after the first rise, as shown in Fig. 2. The great output of the siding and felling teams necessitated our

putting more green girls to hemming. They at first could do only about seventy-five per day, and for several weeks our production line sagged. As they became more skilled, however, it gradually rose, and finally got above the bonus line, the wages per one hundred pieces coming down to the piece-work line. The next drop in the production line was due to the fact that one of the bonus-workers left and had to be replaced by two green girls.

Fig. 2 shows better, perhaps, than any other diagram that I have ever made the advantages of our system of *Task and Bonus,* by which the unskilled can earn day wages while becoming skilled, and then have a fair piece rate. This diagram illustrates the fact that if we had fixed a task and set for it a piece rate, we should have been obliged to confine our efforts to getting girls who were already skilled, for the unskilled ones could never have earned a living while acquiring the skill necessary to do the task.

It must not be forgotten that during this time of training, our time-study man has given careful attention to the unskilled, taught them how to avoid loss of time, showed them wherein they worked differently from the skilled ones, and used every means to encourage them to become skillful.

This element of *training,* which is lacking in the ordinary *piece-work,* we set great store by, and feel that we have done some real good when we have taught an unskilled worker to perform any operation skillfully. This diagram shows clearly that in *day-work the pace was set by the unskilled, while in task-work the pace is that of the skilled.* The fact that in day-work the pace is set by the slow and unskilled is well known, and the reason for it is obvious. It is a characteristic of human nature in general, not of day-workers only, to get all one can, and to give as little in return for it as possible. In this the capitalist sets the laborer an example by which he is not slow to profit. He pays the smallest wages for which he can hire men, and the men in return do only the amount of work needed to hold their jobs, and thus their interests are opposed. Wherever the *Task and Bonus* system has been applied, this condition has been reversed, for all strive to do their best, and are happy in their work.

I said before that the task workers improved in health, and

have stated that this is most marked in the case of women, who, as soon as they acquire the proper skill to do their task regularly, become much more cheerful, and take a far greater interest in their work. This interest is best illustrated by the *peak* in the production line in Fig. 1, which was the result of a race between two teams, lasting several days.

TEARING.

Fig. 3 represents in a similar way the tearing of the cloth into pieces the proper size for pillow-cases. Note that the production line at once ran above the task line, and stayed there, *the wages per one hundred pieces* coming down at once to the minimum rate. The peak in the production line here was also the result of a race.

These races are the best indication of the spirit in the room, and of the entire confidence of the workers that the rates will be permanent.

STUDY OF DIAGRAMS.

These three diagrams are worthy of careful study, for they illustrate some important facts:

First: You will notice that the production line gradually ceases to be full of ups and downs, but becomes comparatively straight, and approximately horizontal, with a slight upward tendency; the workers have taken their *best normal gait,* which increases slightly with growing skill.

Second: This *best normal gait* under our direction produces about three times as much output as the *average gait* under the old system of day-work and supervision.

Third: The output of the skilled workers is approximately 10 per cent greater than the task, except in Fig. 2, which includes the work of some unskilled workers, indicating that we have allowed approximately the same margin in setting each task. We could have made their margin smaller, but it would have taken longer to train our workers. The amount of a margin to be allowed in any case depends upon whether it is more important to get task-work started quickly, or to get the greatest possible economy in the long run.

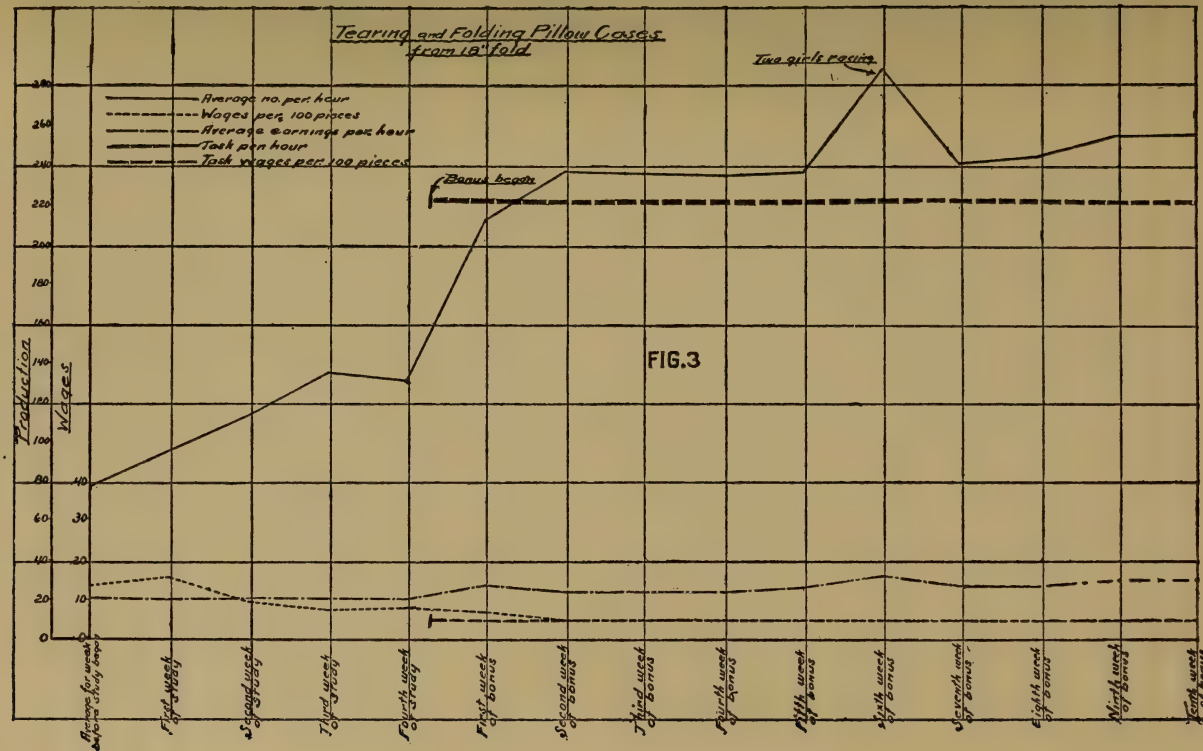

Tearing and Folding Pillow Cases from 18" fold
Two girls racing
Average no. per hour
Wages per 100 pieces
Average earnings per hour
Task per hour
Task wages per 100 pieces
Bonus begins
Production
Wages
Average for week before study began
First week of study
Second week of study
Third week of study
Fourth week of study
First week of bonus
Second week of bonus
Third week of bonus
Fourth week of bonus
Fifth week of bonus
Sixth week of bonus
Seventh week of bonus
Eighth week of bonus
Ninth week of bonus
Tenth week of bonus

FIG.3

Fourth: The *best normal gait* is distinctly below the racing gait, although it tends gradually to increase. The workers may some day do normally what they can now do only on a spurt.

Fifth: The wages per one hundred pieces are less than one-half of what they were, while the output is increased two hundred per cent.

Comparison of Results.

The comment of most people on reading these results will be that the conditions must have been very bad to admit of such improvement. I will admit that they were bad; but the management apparently thought otherwise, for the room had been kept carefully locked, and nobody was allowed to see the methods employed. The fact is, they were no worse than those that exist in most manufacturing plants where day-work and the ordinary untrained foreman are depended upon for efficiency.

From the experience of Mr. F. W. Taylor,* Mr. Carl G. Barth, and the writer, almost unlimited examples could be cited illustrating the fact that ordinary management and day's pay seldom produce more than one-third of what is possible. These examples can be drawn from such widely varying classes of work as shoveling coal, turning steel, folding cloth, barking wood, etc. One example, however, is worth giving in detail as follows:

A concern for which I was doing some work bought a machine for drying cloth which had been highly recommended. There was considerable difficulty in getting the machine to work right, but we finally got it to dry medium-weight cloth at the rate of 160 yards per minute, and set a task of 140 yards per minute, which is being done all day and every day. Before we got the machine to running properly, and while we were trying to overcome some of the obstacles, we asked permission to have our mechanic go and see a machine which was said to be running properly, and giving satisfaction. Our mechanic took occasion to find out just how many yards that machine dried on the day he was there (it ran all day), and found it averaged thirty-two yards per minute. Our

*Stevens, '83.

task of 140 yards per minute is nearly 4.4 times as much as was held to be good work by a very successful company.

Quality of Work.

About the time our *Task and Bonus* system had gotten well started in our sheet and pillow-case factory, a customer with whom we had just begun to do business returned several cases of goods on account of defective sewing. On hearing that these cases were coming back, the foreman stated that he was not surprised, as it was impossible to do good work at the speed we were working. When the cases arrived, it turned out that all the work returned had been done before the *Task and Bonus* system was started. The management at once ordered all the cases on hand, about one hundred, to be opened and inspected, it being inconceivable to them that the task work could be better than the day work. The result was, that while the work done before the installation of the *Task and Bonus* system was about the same as that returned, that done after the installation of the *Task and Bonus* system was practically perfect. The ratio of imperfections before and after being 50 to 1.

Summary.

The results of the *Task and Bonus* system may be divided into two classes: Those that benefit the employer:

Quicker work;
Cheaper work;
Better work;

and those that benefit the employee:

Better wages;
Increased skill, and better habits of work;
More pleasure in work.

The only items in this list that need any comment are the third and the last. We have *better work,* first because of our careful inspection, and also because the attention needed to do high-speed work keeps the mind of the worker on what he is doing, and he

rapidly improves in skill. With growing skill comes increasing pride in doing the work well. These same factors make for greater pleasure in work. Our *bonus-workers* cease to regard the clock as a monitor keeping them at work, but race with it to the end of the day, and feel a pride in doing more than their task, and a satisfaction in getting the increased pay. The total result is coöperation of the highest kind, for not only is each worker doing his best, but doing it in accordance with a carefully planned scheme and the best instructions available. The individuality of the worker is allowed full play, but not until after he is taught to perform his task by the best method we can devise, and then subject to the conditions that he must not depart from that method without permission. His improvement must receive the approval of the task setter, who will see that it conforms to our general scheme.

When these methods here have been perfectly installed, it is not infrequent to find work which has been done at a loss, yielding a handsome profit, and plants that were entirely inadequate for the work they had to do under the old system, having double their former capacity under the new system.

These facts force upon us the conclusion that before building a new plant, or even increasing the size of the old one, we should make a thorough study of the work being done, and assure ourselves that the plant is being operated in such a harmonious manner that we are really obtaining the maximum output. Such an investigation will usually demonstrate that better management and not a larger plant is needed. If it should also show the need of a larger plant, such a plant can then be built much more intelligently than before the investigation was made.

COSTS

By

J. Newton Gunn

So long as men buy and sell for gain, so long must cost be the standard for measuring efficiency of operation and excellence of management.

So long as labor is employed in different states and countries under varying compensation and standards of living, so long will an exact knowledge of costs be increasingly required of both producer and statesman.

Producers have but narrowly construed the term so that an apparently low cost of yesterday is shown by to-day's better experience and knowledge of some neglected element to be not only erroneous but wasteful.

It is difficult to understand how that most vital problem of fixing our tariff has been always attempted with an ignorance on the part of the legislators that may be described only as *epic*. Scarcely less serious is the lack of basic facts in the extensive legislation and attempted control of various public service corporations. In every instance where cost and selling price were involved *no single* instance is known where even an attempt was made to establish costs on a scientific basis and standardized as between the undertakings affected.

In a study of costs of production for over twenty-five years in many hundreds of establishments in Europe and America, the writer has not found an instance where the elements of cost have really varied or where the following formulæ and principles if applied would not have secured more stable conditions to the management.

The study of costs rightly considered is the study of the vital statistics of the whole of a business. A proper agreement is therefore necessary as to the real ends to be sought.

A misapprehension exists or is apt to exist in the proper definition of this title. Cost should always be a statement of fact in

contradistinction to an estimate which may or may not agree with the real cost. The development of cost study is due to the realization on the part of the more thoughtful producers that a most exact knowledge of cost is necessary in order to meet or withdraw from unintelligent and destructive competition if the latter by education cannot be eliminated.

It is no satisfaction to a producer to know that the ignorance of his competitor will destroy that competitor, if another equally ignorant and dangerous follow him. The only hope lies in a complete education of all who enter a given competitive field, else that field is hazardous.

This unintelligence was and is still exhibited:

a. By the manufacturer having a variety of articles which he produces in one shop, averaged or estimated as to costs in such manner as to conceal the losses on one article by the larger profits of the other.

b. By the continuance of manufacture and sale of an article at possible loss under the apprehension that it was a necessary trade condition to have "leaders" carry or make the market for other lines which are highly profitable but high priced. Smug satisfaction in this policy suppresses the real facts as to the aggregate losses—frequently large—as against aggregate profits, too frequently inadequate.

c. By the fancied importance of keeping to a very small item the amount of so-called red tape and clerical work; this latter consideration in the manufacturer's mind has been very properly enlarged by the extension of the so-called cost systems devised by those lacking accurate knowledge of manufacture or of the operation of any enterprise.

d. By the lack of appreciation of the vital necessity of having any facts used in the operating department capable of proof in the final accounts of the corporation or firm.

e. By the lack of carefully planned and organized knowledge and means of using cost facts in modifying methods of production or in the selection of articles for sale or for the control of markets.

The deficiencies noted in the foregoing are still shown, due to ignorance of the real elements of cost of production and the ignorance of the real purpose of costs and the confounding of cost finding with systems of bookkeeping.

The absolute standardization of cost formulæ in all industries is essential if we are to have any intelligent tariff revision, and control and protection of corporations by the government, and any effective legislation for the regulation of trade.

This discussion of costs is designedly elementary and is not concerned with the mechanism of cost finding. Unfortunately for the manufacturer, the general practice is to give much attention to the *mechanism* and to rest in ignorance of the *theory* of costs. The specific illustrations herein will refer more particularly to shop costs or costs of manufacturing but will apply in every way as well to costs of engineering enterprises of any nature. In the securing of costs in a specific case it is necessary to regard:

a. The character of the enterprise.
b. The value of the information when secured.
c. What use should be made of the facts.
d. The provision in the organization of having the facts used as intended.
e. Whether or not those for whom the facts are intended are competent to use them.
f. Whether through proper inspection there is assurance that the facts have been used.
g. In what degree of refinement should the costs be presented.

Costs should be broadly divided into two classes:

a. *Monetary costs* or those in which the several elements are expressed in terms of value; i.e. the *cost value* of fur in a hat, or pig iron in a perfect casting, or lumber in a wagon.

b. *Physical costs* or those in which the elements are expressed in terms of quantity of the various items composing each unit of product; i.e. the number of *ounces* of fur of a given quality in a hat, or the number of *pounds* of pig iron to produce one hun-

dred pounds of good castings or the number of *feet* of lumber in the body of a wagon.

Economically all value in production is the result of the expenditure of labor. John digs from the hillside, which he has preempted, certain iron ore which he sells to William. John has only expended labor and sells his ore to William as the price of his labor. He has one element of cost.

William takes the ore and expends his own and employed labor in converting the ore into pig iron. His cost consists of his labor, plus the ore representing John's labor, which is William's raw material. William, however, has other elements of cost. The power in furnishing the blast requires both labor and materials; and because the costs so incurred are indirect they are called expense; that is, mill expense or factory expense.

William, too, employs many men and because his operations are large has an *administrative* office and men employed in *selling* his pig iron. This is expense but because it is not so directly related to production as the factory expense, is called *commercial* expense and is divided as administrative and selling expense.

So that while all costs of production may be analysed and traced back to the one element of labor, in practice we have material, labor and expense.

Each of these major divisions of cost is subject to subdivision arbitrarily. Such subdivisions are useful in giving a basis for the easier determination of cost and are useful in cost comparisons and reduction.

Labor is broadly divided as direct and indirect; or less happily and inaccurately referred to as productive and non-productive.

Direct labor is that which may be accurately observed and allocated to some specific operation on or to some portion of the product—as digging a trench, turning in a lathe the rough casting that becomes a fly wheel or painting a wagon.

Indirect labor is that which, while as necessary as the direct labor, is not easily charged to a specific item or article or product —as superintending the "gang" digging the trench, attending

the engine that drives the lathe, or buying or accounting for the paint or the labor used in the wagon plant. Indirect labor is treated as a part of factory expense or construction expense.

Direct material (as more frequently termed raw material) is that which enters directly into the article or work and which becomes part of the finished product, as cotton for thread or copper and spelter for the brass in lamp burners.

Indirect material (or as frequently termed mill supplies and factory supplies) is that which while absolutely necessary to production does not physically enter into the articles made; as oil and waste for the machinery, coal for the boilers or stationery for factory and engineering records. Indirect material can only in a few cases be allocated to a specific object of production and is therefore treated as factory expense.

Other factory or construction expenses are generally incurred which do not readily fall under either classification of indirect labor or indirect material. Rentals of water from city mains; steam, gas or electricity from municipal or other outside plants are such indirect expenses. Such outlays are always a part of factory expense.

A necessary accessory to production is the repair or current renewal or provision for restoration and substitution of the tools of production. The provision for restoration and substitution of plant is ordinarily referred to as depreciation; but any provision for depreciation must ever include provision for antiquation or obsolescence of plant. *The essential reason for including depreciation as a necessary item in expense is the obligation that rests on the industrial entrepreneur for the preservation intact of the capital entrusted to him. It matters not whether this capital be his own or his fellows'; it matters not whether the time between occasions of substituting new plant for old be long or short, it is as essential to charge into the cost of the carpet the price of the exhausted capital in the wearing out of the loom, as the cost of the bucket that dipped the dye from vat to vat.* It is therefore but an arbitrary distinction and a fallacious one that treats the price of the file smoothing the casting as a present cost and the price of the lathe worn out in planing a thousand castings as a

cost to be lightly considered by manager or directors or regulators of corporations as pleases their fancy. It is not the general practice to charge depreciation as an item of factory expense but to more frequently take it from surplus earnings. This is done because the earnings of the undertaking may vary so widely from year to year while the necessity for making the cash outlay as a result of depreciation and obsolescence may be deferred.

The most satisfactory costs and those most nearly correct will be secured if certain sums be *charged* in factory or mill or construction or operating expense which shall be credited to *reserves* for repairs, current renewals and depreciation, and when the cash outlay is made for either or all of these three last items it should be charged against established reserves. The determination of these reserves and the calculation of the physical life and antiquation of plant is a subject which has no immediate place in this discussion.

The foregoing may be considered as fairly defining all the elements of factory or mill or construction costs.

Any other indirect costs than factory expenses are not included up to this point as they do not bear so direct a relation to production; being directed to the financial or selling or general administrative ends.

Commercial expense as distinct from factory expense may be well divided into administrative expense and selling expense.

In administrative expense may be included all that outlay for the cost of conducting the business; as the salaries of officers, general stationery, telephones, telegrams and postage; taxes to compensate the state for protection and for government; insurance to protect the capital of the partners and shareholders from impairment by fire, by the death of an important officer or partner in whose personality was vested considerable good will.

In selling expense may be included those expenditures for salaries and commissions of salesmen or sales agents; for advertising and publicity; for traveling expenses; and any other charges incidental to marketing the product.

The consideration of how these various indirect elements of

cost—factory expense, administrative expense and selling expense —shall be calculated for a specific article or object of production is purposely deferred for discussion elsewhere.

Interest on borrowed or partners or shareholders capital is not properly an element of cost. Interest should rather be considered as profit resulting from the employment of capital. It is not, however, important to have a discussion of this part of the subject further than to say that if it is included in cost it must be so completely segregated and so clearly defined in the records of the undertaking that it may not be confounded with the elements of cost properly so called.

It is frequently the practice to include in cost only that interest on borrowed capital or interest at some arbitrary rate on such part of the entire capital as may be invested in plant or property. Either of these latter practices is to be particularly deplored as a half way measure.

In order to express these several elements of cost set forth above, the following formulæ may be useful. (Formula 1.) (See note 1.)

m=material (raw or direct).
l =direct labor.
x =factory expense (or mill expense or construction expense, including d—reserves for depreciation).

—

c_1=factory cost.
a =administrative expense.
s =selling expense.

—

c_2=cost sold.
i =interest or charges for capital.

—

c_3=minimum selling price.

It will be useful to identify the various elements or groups of elements of cost, with corresponding items in a loss and gain statement.

For example:

ITEM.		ELEMENTS OF COST.
(1) Sales	=	
(2) Cost of sales	=	(c_1)
(3) Gross profit	=	
(4) Commercial expense, i.e.,		
Administrative expense	=	(a)
Selling expense	=	(s)
(5) Net profits	=	
(6) Interest	=	(i)

NOTE 1. Modifications of the first formula are given herewith and in conjunction with the text are self-explanatory.

(Formula 2.)

m=raw material.
l =direct labor.
x =factory expense.

c_1=factory cost

a =administrative expense.
s =selling expense.
d =reserve for depreciation.

c_2=cost sold.

i =interest or charges for capital.

c_3=final cost or minimum selling price.

or if these formulæ be expressed in better mathematical form we would have Formula 3, corresponding to Formula 1:

$$m+l+x=c_1$$
$$c_1+a+s=c_2$$
$$c_2+i=c_3$$

or Formula 4 corresponding to Formula 2:

$$m+l+x=c_1$$
$$c_1+a+s+d=c_2$$
$$c_2+i=c_3$$

As important as exactly stating the elements of cost is the insurance of the accuracy of the facts. It is futile to know that the weight and value of raw material is 1,000 pounds, costing $20, if the record of the finished weight of the articles made therefrom shows 800 pounds instead of 950 pounds; giving an apparent material cost for the finished article of 2.5 cents in place of 2.2 cents per pound. Yet such errors do continually occur

through faults in the factory organization that fails to inspect and ensure accurate scales.

Careful criticism and provision for the sources of information is therefore necessary.

Making such provision invariably involves present examination of the whole organization. All of those functions of an organization having to do with the securing, tabulating and using of its vital statistics must perform their work not alone accurately, but promptly, regularly, uniformly, and economically: promptly that the information may be available before the occasion or event has become history; regularly that the values through comparison and *current* use may be secured; uniformly that the statement of to-day may be comparable with that of yesterday; economically that the cost of getting costs shall not minimize the value of the information.

In discussing the relation of costs to the general organization, it must be at once appreciated that that department, which has the supervision of securing, tabulating and digesting for use, cost facts is but a part of the entire organization. Many of the disappointments and defects in schemes of cost determination are in the belief that cost finding is an end in itself and that it may be undertaken irrespective of the condition of the organization. It is a waste of time to consider the cost problem alone; coincidental consideration is given to the condition of the organization and the correction in it of the fundamental defects of management. The reason for this will be quite clear with a single illustration:

Let us conceive that it is desired to get accurate costs in an establishment where there is no centralized control of the receipt, care and disbursement of material and stores; it is further assumed that in this establishment these materials and stores are distributed for fancied convenience in the various departments and places where the materials are to be used and under the general supervision of many foremen or sub-foremen.

Under such a condition an accurate record of materials consumed will be impossible, to say nothing of getting accurate control of the materials, unless an attempt be made to go further and

establish this control on lines of modern management which demands that there shall be pre-determination of the materials that should be used, rather than alone a record of materials that have been used.

All of the problems of organization which should be considered in connection with the utilization of the best efforts of a cost department may not be enumerated and described within the limits of this article, as these must to some extent vary with the magnitude of the undertaking under consideration. From the foregoing illustration, however, it will be perfectly clear that a recognition of specific functions or departments in the organization must be established; such as the departments controlling stores of materials; directing and recording the performance of labor; the custody, maintenance and direction in use of tools and equipment; and that department which coördinates all of the records of an accounting nature, both in the office and in the factory.

The importance of the departmental or functional dividing of the business is not limited to the advantages to be gained by the securing of accurate operating facts, but is equally important in the elimination of wasteful and duplicating effort on the part of the management.

Next in order of importance is to insure the organization of what for a better term may be described as the order systems; that there may be some number or symbol against which every item of expenditure of labor—direct or indirect—of material—direct or indirect—or of expense—either factory, administrative or selling expense—may be charged. For no reliable information of performance will be secured until every item of expenditure is provided for under such a classification of objects of expenditure as will be useful not alone to the accountant but also, and first, to those concerned in the operation of the undertaking.

The sources of cost or cost facts, that is, the sources from which the initial information must come, of necessity must be under the immediate direction of a grade of labor lower than that which is responsible for the general administration and planning of the affairs of the business, such as the recording of

the time taken in the performance of work, or the recording of scale weights of materials consumed. While low grade labor must be depended upon for the performance of the duties incidental to the *securing* of such records, this labor must be under the organized control of a special department that secures, through predetermination of method and inspection the accuracy of the result.

Not only must the sources of information as to expenditure be guarded and carefully organized, but of equal importance is the securing of the information relative to the work performed. Briefly stated, it is the importance of the divisor. Many instances have been found in which, while the factory had been fairly well organized as to its functions, and accuracy had been secured of original records of expenditure of material and labor, the results shown in their costs were entirely unsatisfactory and unreliable, due to the inaccuracy of the record of the product or of the work performed.

It has been previously stated that this article is not concerned with the mechanism of cost finding, but it will readily be understood that if the foregoing principles are recognized and established in practice in any concern, it is of little moment whether the mechanism that actually records, tabulates and presents the cost facts is economical or not. For instance, in a concern employing 5,000 men, where, through failure to properly direct the performance of these laborers, there may be a lost efficiency of from 10 to 40 per cent, it is manifestly unimportant whether there be employed in connection with the statistical department fifty men, or seventy-five, if by employing the larger number, accuracy of facts and promptness of presentation of these facts would be secured.

No discussion is attempted of the various methods of distributing indirect expense further than establishing the principle that there is no relation between factory expense, administrative expense and selling expense that would make it possible to lay down one rule for the loading of these items on to the cost of the product. Ordinarily, factory expenses bear a more direct relation to the value of direct labor than they do to the value of the mate-

rial; and more frequently still, factory expense varies directly as the time through which the labor is expended. In other instances these expenses may be better distributed on to the product by the units of product completed. In undertakings where there is a very great variation of the cost value of the tools employed in production in the same or various departments, it is found desirable to load the factory expenses by establishing a machine rate; that is, a rate per hour of machine performance, which absorbs, sometimes, the direct labor and also all the expenses incidental to the operation of the department or the machine, properly to be classified under factory expense.

The uses of costs have been broadly shown in the earlier part of this article, but recognition should be given to the diversity of forms of management, ranging from that form in which through lack of appreciation or lack of ability to use information only historical costs and those of a simpler character will be needed, to that type of sound management which is concerned, not so much with what has happened in the business, as to insure by predetermination through well-directed scientific effort, the result so necessary to successful operation.

This preassurance of cost within narrow limits involves the predeterminization and standardization in every detail of the design of the product, the quality, price and quantity of materials used; the quality, price and quantity of labor used; the kind of equipment, the specific tool and its speeds and feeds, as well as the sequence of operations and the specific instructions that shall guide the operative in his performance.

AN ANALYSIS OF WORK

By

Herman Schneider

In medicine there are two types of doctors—one at once treats superficial symptoms and one first searches for the basic cause and then prescribes. The first kind gives a headache powder; the second finds the functional disorder which causes the headache and works to remove it permanently. In the long run, the first doctor weakens the resisting power of his patient, while the second strengthens it.

We are paralleling this in our treatment of industrial ills. When there is a general or a particular industrial breakdown, we want immediate relief and take the headache powder cure. Ills in the form of numerous strikes, profit-killing foreign competition, inadequately skilled artisans, large groups of workers constantly shifting and drifting aimlessly from one occupation to another, and an increasing feeling of centrifugal tension where solidarity should exist—these are pressing more urgently day by day; and in response to the need, there have arisen Doctors of Industry, skilled and quack, in rapidly increasing numbers. They are generally specialists—one for the head, another for the heart, another for the stomach; and the body politic is being treated by each independently.

The ills are all ills that grow out of work. They are not a mysterious wasting-away, visitations of Providence, fits brewed by the powers of darkness, or something that runs in the family, any more than headache is. The causes are real and lie within the realm of Natural Law. Therefore, the logical starting point of a diagnosis must be to ascertain the Natural Laws of Work, non-conformity to which causes our industrial headaches.

Now there is a natural law of labor which operates as surely as the law of gravity.

Work is human effort put forth for the satisfaction of wants. It can be shown by history that a people who will not work will fall to swift decay. If you look back along the highway over

which civilization has come, you will see that, except where great physical upheavals of nature, or brute strength in overwhelming numbers have been factors, nation after nation has fallen, because of non-conformity to the law of labor. Every man knows that he will deteriorate physically and later mentally if his muscles are not used. The law could be established scientifically if need be, but it is not necessary, for in this case common observation, science, and religion all agree. Our proverbs, sacred and secular, affirm it. The cycle of work to wealth, wealth to idleness, idleness to poverty and poverty to work again, is an evidence of mental inefficiency, following physical decline.

The substance of the law of labor is this: Work and you will reach a higher mental development; cease work and you will degenerate. The law applies to individuals, to communities, to nations, and to civilizations.

As a compelling prod to drive humanity to save itself, there is another Natural Law, which needs no proof. Simply stated, it is *work or starve.*

We work because we have to. There is an instinct for work, but basically it is the instinct for self-preservation and self-perpetuation. If all the world had a climate like that of the South Sea Islands, it is safe to say none of us would work. Had Nature provided initially for all of man's needs, it is probable that we should be without complex problems, without wars, without government, without what we call civilization—without work. The struggle for existence has brought us to our present stage of development. All that is best in the history of civilization has come from work, and all that is worst, from idleness and the consequent sins of idleness. Mentality is the result of physical activity, and in turn stimulates it. Thinking and working are reciprocal aids. Integrity, honesty, discipline, sound health, fair dealing, respect for others' rights—these have come through the assumption of one's burden of work, and the opposites of these are the result of the desire to dodge the burden.

Now of all the products of the labor of the centuries, there are probably none to which we of this generation look with more satisfaction than to our scientific achievement and our mechanical

ingenuity. And yet these two distinguishing elements of our modern civilization have set up barriers to the realization, by the majority of workers, of the greatest benefit of work, namely, mental development; for they have wrought significant changes in the conditions of work.

In the first place, *it is only within the past two generations that mankind has worked in masses within walls.* For centuries men did individual, self-directed work almost entirely in the open. The change has come, of course, through the development of power devices, and dates virtually from the invention of the steam engine.

In the second place, the industrial worker formerly knew a *whole* job, rather than a part of it; he performed a great variety of functions in the completion of his task, instead of endlessly repeating the same limited operation. The clockmaker made a *whole* clock, working individually, and the necessity of working out every part's relation to every other part gave the worker a mental stimulus, and, therefore, a higher mental development. The finished product was all his own; the desire for self-expression which every man has, found an outlet through his work; and once having served his thorough apprenticeship, he worked largely by self-direction. Under our present highly organized industrial conditions, the making of a clock is subdivided into a large number of distinct operations. Each workman in a clock factory makes piece after piece of the same kind, principally by feeding material into a machine, but why he does it he need not know and usually is not told. We are putting the brains into the machine and into the management office, and making the workman a purely automatic adjunct. It is unquestionable that much of the present spirit of industrial unrest is Nature's protest against work without light, physical and mental.

This purely automatic, high-pressure work in closely crowded rooms is the most ominous feature of modern industrialism, its most serious aspect being the effect upon mental development. Scientific research has shown us that the monotonous rhythmic repetitions of the machine's motion and the monotonous rhythmic motion of feeding the machine, produce an hypnotic, deadening

influence on the mind. The lower brain centers, controlling habits, are developed at the expense of the higher thinking centers. As the habit becomes ingrained, the worker becomes more lethargic and automatic, and almost as incapable of independent, intelligent action as the machine itself. Research further shows that the higher centers in the brain of such a worker are in danger of getting into a permanent, inelastic, hopeless set, if a lively stimulus is not supplied.

Further, there is in every individual a desire for self-expression, and if this cannot be had in one's daily work, Nature will force an outlet for it. It cannot be dammed up very long; and when there is no outlet for it in the worker's daily task, it must come during his idle hours, and sometimes takes a form which leads to many of our most vexing sociological problems.

The situation, then, sifts down to this: Energizing work is decreasing; enervating work is increasing. In spite of the warnings of history, we are rapidly dividing mankind into a staff of mental workers and an army of purely physical workers. The physical workers are becoming more and more automatic with the sure result that their minds are becoming more and more lethargic. The work itself is not character building; on the contrary, it is repressive, and when self-expression comes, it is hardly energizing mentally. The real menace lies in the fact that in a self-governing industrial community the minds of the majority are in danger of becoming atrophied, or at best of becoming trifling and irresponsible, because of lack of continuous exercise in conjunction with the earning of a livelihood. The kind of citizenship that a republic needs cannot be built on sixty hours per week of automatic work. But we cannot reverse our present economic order of things. Automatic work is increasing and will continue to increase for a long time to come. The condition is here and philosophical discussion will not remove it.

It is evident, then, that the general law of labor must be divided into two parts, namely, The Law of Energizing Work, which makes for progress, and The Law of Enervating Work, which makes for retrogression. Nearly all the work still done in the open air, where there is a dependent sequence of operation, in-

volving planning on the part of the worker, is energizing work. Specific examples may be cited in farm work, railroad work and the building trades. Certain work done indoors, under good conditions of light and air, is also energizing; for example, the work of a toolmaker, a locomotive assembler, and a cabinet maker. The enervating work has come through the subdivision of labor in factories, so that each worker does one thing over and over in the smallest number of cubic feet of space. This type is recognizable at once in the routine of the garment worker, the punch press operator, the paper box maker, the shoe worker, etc.

Aside from the broader factors such as climatic conditions and racial characteristics, it is safe to say that the *morale* of a community depends upon the kind of work it does. A rural community of about twelve thousand people, having clean political conditions, a high moral tone, few jarring families, well-kept gardens, and a good average of intelligence, is a desirable place, from the manufacturer's viewpoint, in which to locate a factory. If a manufacturer locates in such a place and employs three thousand of the men, women and children in purely automatic, noisy, high-speed work, the town will change very materially in one generation. Its politics will become corrupt and its morals lax; its citizenship will lose its former mental stability and fly eagerly and earnestly from one spectacular "ism" to another; its families will be on nervous edge with family discipline gone; its yards and houses will lose their tidiness; saloons will increase; in a word it will become "a factory town." And what was once a good community with a high community efficiency, and therefore a safe place in which to invest money, becomes a town of low community efficiency and a constant menace to the industry itself. Every detail of the town's life is affected. Religion lags, while the amusement parks thrive on Sunday; for since the week-day work is repressive, an outlet for pronounced self-expression is demanded in the idle hours—or to put it another way, Nature goes on the defensive. The slowly up-built appreciation of the fine arts is quickly destroyed, for this cannot grow without harmony, orderly thought and the desire to express ideals. Respect for law diminishes, for the law is put in the same class

as an electrically wired strike fence. These significant changes are not the fault of the people who work; they are logical natural products of the work itself.

For the purpose of analyzing work, a scale has been devised, in which the most energizing work is at the 100 per cent point, and the most enervating at the zero point. The 100 per cent work is that of the locomotive engineer. This has been selected because his work has the following elements:

(a) It is done in the open air.

(b) It provides a well-rounded physical development.

(c) The constant improvements in locomotive design and railway appliances generally require continuous mental development.

(d) Mental alertness is constantly required for emergencies.

(e) A comprehensive grasp of the whole interdependent scheme of production (a railroad produces transportation) is essential.

(f) The conditions under which the same run is made are never alike.

(g) The work itself,—not lectures or preachments or popular acclaim,—*the work itself* breeds in the engineer the highest quality of good citizenship; namely, an instant willingness to sacrifice himself for the lives in the train behind him.

The zero points on the scale, or the most enervating work, is the work of a girl in her formative years in a steam laundry, when the following elements prevail:

(a) Supersaturated, vitiated air.

(b) Standing in a strained position.

(c) The work consisting of feeding one piece after another of the same kind at high speed into a machine.

(d) The hours of work being so long that fatigue poisons accumulate.

The scale is crude and lacks scientific accuracy. A statement, for example, that the work of a laster in a shoe factory is 40 per cent energizing would be a guess. But the purpose of the scale is

not so much to arrive at a percentage as to establish some standard of actual work for the purpose of diagnosis and treatment. Three investigators, analyzing the work of a laster, might classify it as 30 per cent, 40 per cent and 50 per cent energizing. The differences in their classifications would lead to a closer analysis, and hence to a surer treatment.

To take a specific analysis, consider two adjoining weave sheds of a silk mill. Going first to Mill A, you find a long room with an aisle down the center, on each side of which are the machines. Between the machines there is ample space for the operative (nearly always a girl) to go up and down tying the broken threads. In the main aisle and adjacent to each machine is a chair. When the girl has finished one round of her machines, she rests for a short period of time, and in this way fatigue is prevented. The two girls of adjoining machines usually time their rounds so that their rests come at the same time. The noise in the mill is so slight that they can converse without any effort. In the center of the room in the main aisle is a washstand at which there are usually about six girls, cleaning gum from their hands. The light is good, the air is not vitiated, the rest periods are sufficient, and there is no nervous tension from noise or speed, the work is not monotonously automatic, the position of the body is not strained; but on the contrary, many muscles are lightly brought into play. However, the work itself does not stimulate any mental activity, nor develop any of the finer and higher mental qualities. It may be classed as about 70 per cent energizing.

The silk after leaving this mill is sent to Mill B, where a number of strands are woven into a single strong strand. Since the silk is strengthened, the machine can be run at higher speed. On entering Mill B one is confronted with a noise so great that talking is entirely out of the question. The layout at Mill B is precisely the same as at Mill A, except that there are no chairs in the aisle. There are no rests between the rounds which the operator makes of the machines, since the speed does not permit. Talking is impossible because of the noise. This mill is at once diagnosed as the sore spot of the concern. The investigator is

enabled to say to the owner: "This is your trouble center; here is where agitation begins. Many more operatives leave this mill per year than leave Mill A. These workers are suspicious of each other's actions, particularly of the foreman's. They feel that you are their natural enemy. The foreman himself is a grouch. More jarring families, more unkept back yards are represented here than in Mill A, and finally the actual efficiency of this mill is much less than in Mill A, and the work more strenuous." The work is classed as low as 10 per cent, and yet the only difference between the two mills is in noise, speed and lack of rest. The noise is a mechanical engineer's problem, possible of solution. The speed and the fatigue are within the owner's control. With these three factors eliminated, the work would go up to 70 per cent energizing; as much work would be produced under the better conditions, since the force could be kept as intact in Mill B as in Mill A.

Two Doctors of Industry would treat Mill B in opposite ways. In order to increase the production, one would increase speed, ignore the noise, study the motions to eliminate waste moments, and by the unanswerable argument of figures show you that production must go up. This is the headache powder method, and leads to a constantly broken, shifting, dissatisfied working force. The second Doctor would decrease the speed, cut down noise, insist on carefully determined rest periods, and thereby maintain a sound organization of skilled workers; and, what is of equal importance, he would raise the general efficiency and hence the economic efficiency of the community; nor would he stop at that, for he would further strive by known methods to introduce additional conditions, so that the work in both mills would be brought to about 80 per cent, which would probably be the limit for this class of work.

It should be noted that where the work is done under conditions which permit the operatives to talk, without interfering with their work, the rating is much higher than where such is not the case. When we walk, our habit cells control the action, but we can walk and think at the same time. This holds, of course, in automatic occupations. If the motions are not too

rhythmic, both of the hand and the machine, and conversation is permitted and encouraged, the work is not nearly so repressive. In a certain mill, employing girls at strictly automatic work, the employees were placed facing one way, so that one operative looked upon the back of another; between adjacent operatives was a small partition. This mill had to replenish its entire force each year, until the scheme was changed to a round table plan, which encouraged conversation. After this, the losses were normal.

An interesting case of shop psychology is the following: In a certain piano factory, a number of girls were employed to assemble the mechanism which transmits action to the strings when the key is struck. Each girl attached a piece with a limited number of motions, and was paid on the piece-work plan. These employees were the most discontented in the firm, and were constantly shifting to other occupations. Various means—such as rest rooms and decorated surroundings were tried without success. As a last resort, the foreman got a fine, big, maltese cat and placed it in the room one morning, before the girls arrived. This solved the trouble completely. The cat compelled rest periods, for every now and then it would jump into a girl's lap and take her attention from her work for a few moments, and in this way relieved the tension of the high speed and permitted the elimination of fatigue poisons at irregular but sufficiently frequent intervals. Every girl planned at home to bring something in her lunch basket for the cat to eat, whereas attempts to get them interested in the decorating of rooms failed. When girls left this firm and went elsewhere, where there was no cat, they quickly returned. Production increased and peace reigned. The commercializing of a woman's home instinct for a cat, probably energized the work 10 per cent. It was found also that the introduction of the cat began to arouse an interest in the other betterment plans, which had originally failed. This particular case is worthy of a very careful psychological analysis.*

* It should be noted that the superintendent surreptitiously put the cat in the room one morning before the girls came to work. This provided the essential element of *discovery* and therefore of *possession*. If the girls ever go on a strike they will take the cat along. It is *their* cat. How would the average betterment-expert have handled this?

The details just stated are cited not so much to show specific methods of procedure as to emphasize the basic fact that we are, individually and collectively,—human units, towns, states and as a nation,—what our work makes us.

We have just pulled out of a thousand-year swamp up to firmer ground, and whether we go higher or begin to slide back depends upon how energizing our work is.

It is fundamental that mankind must do stimulating work or retrogress. This is the bed-rock upon which our constructive programs of education, industry, sociology—of living, must rest.

Fortunately we are now far enough away from the thousand-year swamp so that one may safely propose as a thesis, that only that civilization will prevail whose laws and life conform most nearly to Natural Law. The Spirit of Unrest, whether it be evidenced by the spontaneous and seemingly unaccountable strike of automatic workers, the questioning introspection of university faculties, the open defiance of law, or the cry for the Doctor of Industry, is the headache giving warning of deeper seated organic trouble.

The worth of our education, our laws, our scientific management, will be determined by the extent to which they will make clear, conform with and supplement the laws of work. Their test will lie in the degree to which they are useful in leading us safely forward to better, brighter conditions of work, and their basic idea must be service to the mass.

I like to think we are coming to a time when the great march forward of civilization will not be largely a matter of chance, with the blind often leading the blind, but more an organized orderly movement in conformity to the Laws of Nature. In that day the opportunist will not vault into the saddle of leadership when humanity, having been badly led, cries out for a leader; instead, he will be a part of history with the medicine man of the savage, for at the bottom both of these in their creation and in their haphazard panaceas are the same. On the contrary, humanity will send out a well-trained, well-equipped vanguard of research men —physicists, bacteriologists, chemists, psychologists, biologists, economists—to explore beyond the ranges of the known; it will

send its historians back over the line of march to learn the lessons of past successes and failures; it will establish outposts where the facts uncovered will be formulated into laws; and from the outposts to the last mite of humanity will be an established way for the application of the law to the need.

WHAT IS A BANK?

By

Frank A. Vanderlip

The importance of the part played by the banking business in the modern industrial and commercial system is so obvious that it cannot be doubted even where it is but imperfectly understood. Its relations to a highly specialized society are analogous to those of the vital organs to the human body; when its functions are interrupted there is paralysis throughout the system.

The lower forms of life are so simple that you may cut through them and subdivide them at will without any impairment of vitality, but as organization develops, with a circulatory system and coördinate functions for the several parts, this independence of the parts is lost. And so in a primitive society the individual is comparatively independent, but as organization takes place and specialization proceeds and the exchanges of civilized life develop, the well-being of the individual becomes more and more dependent upon the perfection and regularity and stability of the system by which the exchanges are made; and banking, through its various functions, is the most important agency to this end.

These functions have been developed with the development of the exchanges and to provide facilities for handling the exchanges. They are a part of the necessary equipment of modern society, without which the present volume of trade, the existing distribution of population and the prevailing style and scale of living would be impossible. Our civilization is based upon the division of labor. Its industrial efficiency, its wealth of production, its comforts and luxuries and variety of opportunity are the results of organized and coöperative effort. If each member of the community, instead of supplying all his own wants, devotes himself to one thing and all exchange these surplus products with each other, the sum total of production and of their possessions is increased. By this arrangement individual aptitude and talent is encouraged, capital is utilized

and the advantages of enlarged and systematic production are secured. But economies and improved facilities in the exchanges are as desirable as in production; in fact, the people who are engaged in transportation and trade and banking are engaged in producing the goods at the place of consumption. And the lower you can reduce the cost of making the exchanges the nearer you come to endowing each man with the skill of all the race and the resources of every land and clime.

The first important requisite of commercial intercourse was a common measure of value. Money was the first great facility of trade. Its convenience as a common means of payment was great, but the after effects were vastly more important. It created a new language, the language of values, which compares with barter as speech does with sign language. It made prices and markets possible and enormously increased the possibilities of trade. Men could understand each other when they talked of values in terms of money, and in the precious metals they found a common denominator that brought all values into relation with each other.

This use of money as a measure or resolvent of values soon extended far beyond its use as mere currency. Grain and cattle and cloth and personal services could be valued and compared in terms of money and exchanged without any money changing hands, or with only the balances paid in money; and this system of refined barter has developed until the commerce of the world revolves upon the grain of gold as an axis, with almost insignificant payments of money. The system was complete when the credits arising from the sale of goods were dissociated from the goods and became a new and distinct species of property, which could be traded in, transferred, merged, or cancelled by corresponding debits.

The fundamental feature of this system of settlements is the fact that in the long run the exchanges settle themselves. All sales are made for the purpose of obtaining the means of making purchases. Broadly speaking, all income is disbursed, either for current expenses or for investments. The wage-earner pays out usually a large part of his income for living expenses and the

rest in payments on a home or to a savings bank. The business man disburses his receipts for goods or materials, labor, rents and the various costs of doing business, and the surplus to enlarge his business or for private expenditure or investment. Every item of one man's outgo is an item of another man's income and in the aggregate income and outgo must balance, both for individuals and communities. A country cannot continually buy more than it sells or sell more than it buys unless there are compensating transactions under other names. It would take the entire stock of gold in the United States to pay for the goods we import in a single year, if gold was the only means of payment; clearly foreigners could not continue year after year to sell to us in increasing volume unless they were taking payment in commodities which we produce in corresponding supply. Fluctuations in the movement of commodities between countries and localities will naturally occur, resulting from the varying yield of the crops and other conditions subject to change, and the temporary discrepancies are bridged over with money; but the broad fact must be recognized that trade is essentially reciprocal, and therefore the credits and debits that arise in the exchanges, if they can be brought together, will practically offset and settle themselves.

This task of bringing together the multitudinous transactions of the business world, in order that settlements may be effected without the risk of robbery and cost of transportation and loss of interest attendant upon payments in money, is one of the functions of banking, and perhaps the earliest one to be developed. Certainly not only the Italian traders of the Middle Ages but the Romans before the Christian Era were familiar with the bill of exchange, for when Cicero was about to send his son to school at Athens he wrote to inquire "whether he can take a Bill for the money he will want in Athens, or whether he must take the money itself with him." This indicates that the settlements between distant cities were handled substantially then as now, by a system of book entries and offsets, if not through banks like ours, through regular dealers in exchange.

If a man in Athens had a payment to make to a resident of

Rome and at the same time had a like payment coming to himself from another resident of Rome, obviously the simplest way to accomplish both settlements would be to have his Roman debtor pay his Roman creditor and send the receipt to Athens. Or if he had numerous dealings in Rome he might empower one agent to collect all that was coming to him and pay all that he was owing. But one man might not have both credit and debit transactions with different people in a distant city; he might, like Cicero, be only a buyer, or he might be only a seller in that market; and so the exchange dealer was developed as the agency for bringing the debits and credits together. It is safe to say that on the very day that Cicero bought his bill on Athens some Athenian was buying a like bill on Rome, and when the two instruments reached their destinations they balanced and cancelled each other. Moreover, if Athens wanted to pay Alexandria, or Damascus wanted to pay Corinth, it is likely that a bill on Rome was the medium, for it is easy to conceive that Rome in those days must have been the clearing-house of the world and that a credit there would be good anywhere.

It doesn't take a mercantile community long to understand facilities like these. It is probable that mercantile houses in the regular trade were the first to buy and sell credits in distant cities, but as the exchanges multiplied the traffic would naturally centralize in the hands of exclusive dealers, and the more so as the element of time became increasingly important and called for the employment of large capital. When Cicero bought his bill on Athens the exchange dealer sold his own credit for cash, but a Roman merchant forwarding a bill of goods to Athens might prefer to sell his prospective credit for cash, in which case the exchange dealer would be buyer and have the credit to carry to maturity. This, as a matter of fact, is the common form of foreign exchange transactions, and it includes a larger service than the mere settlement of maturing credits. The exchange dealer has bought the account, and the shipper, instead of awaiting the delivery of the goods and the arrival of the remittance, comes into immediate possession of the proceeds and can turn them back into his business. Evidently a new and

useful subdivision is here established in the circle of exchanges. The manufacturer or merchant, having effected the sale and converted his goods into a credit in terms of money, is at the end of his function, and the sooner his capital is released from that transaction and returned to the field in which he is a specialist the better. The dealer in credits, or banker, whose specialty it is to arrange the liquidation of such credits, bringing them together by corresponding dates and places, now steps in and for a small consideration carries them to maturity and makes the collection.

The advantages of settling the credits and debits of trade by this arrangement of offsets were doubtless more apparent at first where cross-payments were to be made between distant localities, but another development was under way which was destined to extend the system to include practically all classes of payments. That development was the growth of deposit banking. This type of banking was also known to the Romans in its primitive form, which was simply that of a safe deposit business. They had a custom of keeping coin with an agent and making payments by personal or written order, but the custodian had no right to use the funds on his own account. He was paid for his care-taking and the advantages to the depositor were in safety and convenience. An account which dates from 1584 of banking in Venice says: "Buyer and seller are satisfied in a moment, while the pen moves over the page; whereas a day would not be enough to complete the contract for a great mass of merchandise by counting a great number of coins." There is plenty of evidence, however, that long before this date private bankers in Venice had been receiving deposits and using them in private ventures, but with such disastrous results that in 1587 the State created an institution to take over the banking business of Venice and conduct it strictly as the custodian of money consigned to its care. The Bank of Venice made no loans, and accepted no deposits but cash.

The great banks of Amsterdam and Hamburg in the seventeenth and eighteenth centuries were of the same class; and the first deposit-banking in England, that of the goldsmiths, began in the same way. They had strong boxes for the protection of

their own valuables and consented to receive money for safe-keeping on a small charge. As experience showed that in the usual course of business withdrawals and deposits offset each other it became apparent that a considerable portion of the deposits might be loaned and made productive. This is where the goldsmith became a banker as we understand the term. His relation to the deposits underwent a radical change; instead of being the custodian he became the owner. He was in debt for them, but they were his, and, subject to the provisions he must make for repayment, this hitherto dead capital became available for use. From being a mere convenience he became an active and independent factor in affairs.

The change was of tremendous importance. It signified much more than the release of a given amount of coin for circulation. It created a vast fund of credit which used with moderation and understanding had all the potency of the highest form of capital. Credit is not a substitute for capital, but it is a most effective agency of capital. It is capital's other self, endowed with the powers of the principal but possessing an elasticity and mobility which the principal does not have. If it has been misused in ignorant hands with calamitous results that is no more than has happened with all the great forces and influences that contribute to the progress of the world.

The banks of the United States hold about $1,500,000,000 of money and they have approximately $15,000,000,000 of deposits and $12,000,000,000 of loans. If they were doing business under the old plan, and could possibly gather up $1,500,000,000 of money, that would be exactly the amount of their deposits and their loans and discounts could not exceed their capital. It is impossible to conceive of the modern industrial and commercial organization without the modern system of banking.

The banker, evolved from the goldsmith, was an intermediate species; he was primarily a dealer in money and incidentally a dealer in debts and credits. He received for the most part money and loaned money, for that was the custom of the time, but from him has been evolved the banker who deals primarily in debts and credits and only incidentally in money.

The banker has become the bookkeeper and settling agent of the business world. The products of a locality, let us say the State of Georgia, move out to the markets of the world and create credits in favor of that locality on the books of banking institutions in the commercial centers, while at the same time a counter movement of commodities is under way from other localities into Georgia, in like manner creating credits for those localities which are debits against Georgia. The practical effect is that the commodities moving between these communities are exchanged and pay for themselves, the running accounts being kept and settlements effected in the banks.

To illustrate the details: A dealer in cotton in Atlanta makes a sale to a mill in Fall River and receives in payment a cheque or draft drawn on a New York bank, which he deposits for the credit of his account in an Atlanta bank, and which the latter forwards for the credit of its bank account in New York. Meanwhile an Atlanta merchant has bought goods in New York and in order to pay for them buys from the Atlanta bank an order for the New York credit, and this when forwarded completes the circle of payments for cotton and goods.

If we would extend the investigation to include the bank accounts of the Fall River mill and the Atlanta dealer we would find, first, that the mill account was built up constantly by deposits of cheques and drafts received in payment for goods sold in all parts of the country and perhaps all over the world, with almost no deposits of cash, and that it was drawn down by cheques for raw cotton, and supplies and large amounts of cash for the pay rolls; second, that the cotton dealer's account was built up entirely by deposits of cheques or drafts received for cotton shipments and drawn down by cheques and cash payments to farmers for cotton.

For payments at a distance and for large payments everywhere, bank credit in the form of a cheque or draft is used; for wages, payments to farmers and the retail trade, money is commonly used, but the practice of keeping a bank account and making payment by cheque constantly grows and encroaches upon the use of money in those fields. Moreover, the "money"

of retail transactions is usually only another form of credit—bank notes, government paper, or metal coined at an artificial value. Money as a mere medium of purchase is no more than a token or ticket or order for a certain value; even gold coin has no other significance in such use. We cannot do without gold as the measure of values, as the basis of our monetary system and as the money of international payments, but it is too costly to be used as a common instrument of retail trade.

During the panic of 1907 an amusing story went the rounds, of an Irishman who called at a bank to draw his deposit. The cashier offered him a clearing-house cheque and explained that it would be accepted everywhere and serve all the purposes of money. The Irishman listened attentively and said: "Yes, I understand; and if the baby at our house wakes up in the night and cries for milk I suppose I am to give him a milk ticket." We all laughed at the Irishman's wit, but why? A man doesn't want a government note or a gold coin in the same sense that he wants food. He wants money for the same reason that he wants a milk ticket, as a means of getting something else.

The money which the banks supply to the Fall River mill and Atlanta dealer for pay rolls and cotton purchases quickly finds its way into the tills of the town merchants and back into the banks to be used over again. If there was only one bank in a town and every payment from a car fare up was made by a ticket or note transferring credit in that bank, and there were no transactions with the outside world, and all tickets or notes were deposited at the close of each day, it is evident that the condition of the bank would be the same from day to day and the business of the community would "clear" itself. That is a microcosmic, though foreshortened, picture of the trade relations of the world.

The banker setting up in business pays in a given amount of capital as a guaranty of his own responsibility, establishes his connections in the principal commercial centers with which his community has relations, and invites customers. He receives some idle hoards, some money from customers engaged in the retail trade and provides such part of his capital in money as he

thinks prudent, but the bulk of the deposits that flow over his counter consist of instruments of exchange, which make him the owner of credits on the books of various other banks far and near. He gives the depositors credit on his own books in payment and undertakes to place credit at their disposal wherever they want it or to pay them the full amount in lawful money on demand. The latter is the perilous part of his undertaking, but the condition is peremptory. The efficiency and usefulness of a banking system depend upon the absolute and certain fulfillment of this undertaking to pay cash on demand. A banking system must be so organized that its individual members can pay cash, i.e., lawful money, on demand, and the public must have confidence in their ability to do this beyond the possibility of failure, or the system is not fit for the vast responsibilities that devolve upon it. The task of gathering together the scattered credits which are daily assigned to him and of furnishing his customers with the credits they want at distant points is not difficult. Of one hundred men who come into the bank perhaps fifty will want to deposit drafts on distant cities and the other fifty will want to buy drafts on the same or other cities; he sells the latter what they want, transfers the deposited credits to meet them, and closes the day's business in practically the same condition as before.

The foregoing illustrates the movement of the exchanges constantly proceeding not only between the different communities of one country but between the communities of different countries. There is a network of relationship between banks through which each local community and market is connected with all other communities and markets in the world. No locality is so remote as to be outside of the circle and no community's sales and purchases are so scattered but that they can be brought together in the settlements. Each bank is the center of a circle of which it is the clearing agent; all payments between its own customers may be made by a transfer of credit upon its books. If there are two or more banks in a town, all payments between their customers are resolved into offsets between these banks, and in like manner all payments between localities are resolved

into offsets between banks, and if not settled in local centers are passed up to larger and larger clearing centers until they reach New York for this country or London, the recognized clearing center of the world.

But while the cross-payments of trade may be depended upon in the long run to balance and settle themselves, it does not follow that they will do so from day to day, or that they coincide so closely that payments in money are never required. An individual's sales and purchases are seldom made at the same time, and the sales and purchases of communities are not constantly balanced. The trade of a one-crop farming district will not be so evenly balanced as one of a district in which mixed farming prevails, and in every industry there are periods, usually recurring every year, when the payments exceed the current income, and corresponding periods when income exceeds outgo. This means in the case of the individual that at one time he is building up his credit balance with his banker and at another time drawing it down, and, unless he has more capital in his business than he can employ constantly, he will be wanting to borrow credit. And so a region like the cotton states, whose products move quickly to market, may have large credit balances at one season and at another be wanting to borrow.

In fact, these fluctuations are always occurring and they furnish the banker his opportunity for profit. The banker is an equalizing agency in the situation. He stands in the breach: he must either supply the missing offsets of credit, or, as a last resort, make the payments in money. We have seen that if the exchanges are running in favor of an individual because he is temporarily receiving more than his average of payments he will necessarily be piling up a credit balance with his banker, thus supplying the latter with lending power to aid some one who is a debtor in the exchanges. If a farmer sells his crop and receives his year's income at once in shape of a bank credit, he has the privilege of drawing upon it until it is exhausted, but the fact that he will receive no more for a year practically compels him to make it last throughout that time. Meanwhile the purchasing power of his crop is in the hands of the bank and

may be loaned under conditions that will secure its return as fast as the farmer, or the average of a hundred such depositors, will call for it. Evidently the fact that the farmer accepts the bank's credit as cash, although he will actually use it in installments throughout the year, has served to spread the purchase and distribution of the crop over the year. And for this use of the bank's credit the borrower pays interest. He might have made an arrangement to buy the crop of the farmer direct and pay in installments, but the farmer prefers a closed transaction and a credit in bank subject to cheque.

Not only has the banker the power to loan the credits which his customers have transferred to him, but he has the right to create new credits for his customers in exchange for their notes, thus expanding the total volume of credit. This power gives an elasticity to banking facilities which they would not otherwise possess. The only limitation upon this creation of credit, or purchasing power, is the ever-present requirement that all cash credits must be liquidated in lawful money on demand. This possible demand for cash in uncerain amounts is the sword of Damocles that hangs over the banker's head.

The entire system of settlements, with transfers and offsets and advances and interchange of capital and credit, is exceedingly interesting and wonderfully simple and effective, but depends for its effectiveness upon a scrupulous observance of the principle upon which it is based. That principle is the natural reciprocity of trade. If one set of customers are for a time receiving payments in excess of the average due them and thus piling up balances that may be temporarily used the banker is bound to remember that later these customers must receive less than their average and will not only need to use the credit that is due them but be borrowers in their turn. These inflexible conditions circumscribe the banker and dictate the character of the loans he may make. Credit should never be a substitute for capital, at least not in the banking business; it should always be the representative of capital and never get far from its principal. The credit used in the exchanges should be based upon capital employed in the exchanges, with constant liquida-

tion and interchange of the two. The idle credit upon the books of the bank to-day may be used to move wheat to market or to weave cotton into cloth, in confidence that in a few weeks or months at the latest this property will be converted back into credit and be available for use elsewhere. It cannot be safely used for the construction of a building or the purchase of machinery, however satisfactory the annual returns from such investments may be, because the nature of the property gives no assurance as to when the principal will be returned.

It is not strange that with banking an open and competitive business, these essential conditions should not always be observed and that occasionally a banker should fail in the supreme test—ability to meet all demands in cash. And as credit, with all the potency that it borrows from capital, is itself an intangible thing, mere opinion, that a whisper may destroy, with the interdependence that exists between bankers and between bankers and customers, such failures may easily have far-reaching and disastrous effects. The very economies of the system, the manner in which each man's credit and capital are merged in the common fund in order that all our productive powers may be completely employed, are responsible for an all-pervading sensitiveness, which is the most serious weakness of the system. The moment apprehension becomes general the effectiveness of the system is destroyed.

While there are balances from time to time in the exchanges between countries, and between different localities of the same country, which cannot be settled without shipments of money, they are usually met without inconvenience unless there is a disturbance of credit. All demands but those arising from alarm about credits can be estimated, and credit can be more or less used in meeting them, the adjustment in such cases being chiefly a question of the price to be paid for whatever accommodations are wanted. In some instances, however, the facilities or restrictions of the banking system in respect to the use of the various forms of credit determine whether money must be moved or not.

The movement of the crops each year in the United States

requires an important movement of money from the centers to the agricultural districts, but this is not so much in settlement of a trade balance as to provide a medium of making payments to farmers. As they adopt the custom of keeping bank accounts and giving and receiving cheques this demand for money will decline, or if we had a scientific bank note system it could be met with that form of bank credit.

A crop failure may deprive a locality of the usual supply of commodities upon which it depends to make good its side of the exchanges. Its buying, although possibly restricted, goes on, and eventually the balances must be made good by the sale of property or the negotiation of outside loans, or the bankers must ship out money. A few years ago the southwestern states of this country suffered from a severe drought. The crops were a partial failure and the usual shipments could not be made. Moreover it was necessary to ship grain in to feed the stock on the farms. The balances were naturally against the bankers of that section. The forehanded farmer who had a credit balance at the bank had a right to draw on it to buy grain, and it was for the bank to find the means of meeting the draft. It could call on the farmers who were its debtors to ship their stock or any other movable property to market, or to mortgage their farms to outside loan companies if they were not already mortgaged, or it could borrow of an outside correspondent on its own credit, or after exhausting its cash reserves it could close its doors and wind up business; and all of these things were done. Some method by which an outside supply of credit could be made available to the local banks would tide such a community over its emergency.

In the several years immediately preceding 1897 the agitation over our standard of value created alarm among foreign holders of our securities and caused the latter to be sent home in large quantities, thus creating adverse balances for us and forcing the shipment of gold in settlement. In that case we could not interpose our credit to stop the drain, for it was the impairment of our credit that was causing the movement.

One of the most notable movements of gold that ever occurred

was that from London and the continent of Europe to the United States in the last two months of 1907. Conditions in Europe throughout the year had been such that the banks were reluctant to lose gold, and had raised every possible obstacle to its going, but in November a combination of circumstances made all opposition useless. The crop movement in the United States was on and European buyers wanted the commodities. The panic in this country put such pressure on the banks for cash that they used pressure to hasten the crop forward; the demoralization in trade resulting from the panic was so great that importers cancelled many of their foreign orders for goods. The security markets of this country were so low that European investors improved the opportunity to buy heavily of our stocks; and, finally, the suspension of cash payments created a premium upon money which furnished an additional incentive to import gold. Altogether the forces were irresistible and over $100,000,000 in gold was transferred to this country. Here again it is to be noted that the conditions were abnormal and due primarily to a breakdown of credit, and that this breakdown occurred not in the countries from which the gold was moving but in the country to which it was taken. The operations of our banking system were interrupted by panic and the only means of restoring confidence and order was by the importation of gold.

It will be seen that practically the only interruptions that occur in the regular and satisfactory flow of the exchanges through the banks, or to the performance of any of the banking functions upon which the business community has learned to rely, have been due to apprehensions about the integrity of credit. These apprehensions relate at first to only a few banking institutions but spread until all are directly or indirectly affected, and regardless of whether there is basis for suspicions or not. Experience has shown that the problem of preventing these disturbances is largely a question of bringing some higher or better known credit to the support of the particular factor which is threatened. How this may be effectually done will be considered later.

A simple statement of the functions of banking should be

sufficient to convince every one that they are useful, legitimate and indispensable, and based upon principles fundamentally sound. The banking business does not sit at the crossroads of the exchanges to take toll by any legerdemain, or by any privilege or monopoly, or in any sense as a non-producer. Its services are as distinct and creative as those of any industry and the benefits are distributed to all the consumers of the commodities handled by the exchanges. It is a business that never can be a monopoly, for it controls no natural resource or opportunity; its earnings are from current business and its customers are alternately debtors and creditors and must be satisfied in both relationships or they can easily form new connections.

The problem of perfecting the banking system to enable these functions to be performed with greater economy, efficiency and certainty is not a problem of helping bankers but of perfecting the organization of society.

STORY OF NATIONAL BANKS

By

Frank A. Vanderlip

Two considerations of great importance were named by the Secretary of the Treasury, Salmon P. Chase, in his original proposal for a national banking system, submitted to Congress December 9, 1861. One was to provide the country with a national currency, secured as to redemption by the bonds of the government itself, which would circulate at a uniform value in all sections; the other was to create a new demand for the bonds which the necessities of the Civil War were compelling the government to offer in large amounts, and on which, up to that date, the net interest charge was more than 6 per cent per annum. The men who designed the national banking system of the United States tried to serve two masters. The result has its unfortunate side. They tried to serve the people by designing what they hoped would be a sound, well-guarded, effective banking system. At the same time they tried to serve the government by creating a fictitious market for a vast amount of government bonds. It may be well within probability that the fundamental errors contained in the banking act in the half century during which they have hampered our domestic development and fettered our advance to the position we are entitled to occupy in world finance, have cost the people of this country as much in dollars as did the war that gave rise to those legislative errors. The cost of a bad banking system, in a nation of such vast and active commercial resources as ours, is really incalculable. We have through most of our history grown commercially in spite of bad banking laws. Unresponsive and inadequate as our banking act is, it still was a great improvement over the bad legislation that had created most of the state banking systems in the period of complicated unsoundness and inadequacy that preceded the enactment of the national bank act.

The common currency of the country at that time was state

bank notes, the value of which, as the Secretary of the Treasury said, was "dependent upon the laws of thirty-six States, and the character of some sixteen hundred private corporations." So far as the proposal had in view the improvement of banking conditions it related almost exclusively to regulation of bank note currency, and so great was the need for reform in this respect that Alphonso Taft of Cincinnati, father of President William Howard Taft, writing to Secretary Chase two days after the report was published, expressed the opinion that "if Congress would adopt his recommendations for a national currency that in itself would be no inconsiderable compensation for the War."

Prior to the establishment of the national banking system the bank note was the most familiar form of bank credit in the United States, as it still is in many countries to-day. The first extensive use of bank credit everywhere was in the form of circulating notes; the chequing account, which has become so common with us, being a later development. There were various reasons, in the earlier development of banking facilities, why the note should be preferred. The individual would find bank notes more generally acceptable than his private cheque. The bank's credit was more widely known than his own. Comparatively few people had bank accounts and people preferred to receive payment in something that could be paid out directly without inconvenience. The bank note was a means of extending the use of bank credit to a large class of people who otherwise would not employ it at all. A bank accepted the note of a customer, with such security as it might exact, and gave in return its own notes payable in coin on demand and printed in denominations convenient for use as money. The borrower made his payments with these and the recipient, instead of presenting them for redemption, likewise paid them out as money, and so they were passed on from hand to hand as a substitute for coin. Upon a given amount of coin reserves it was possible to keep in circulation a much larger amount of notes. The excess represented bank credit doing the work of capital.

It is significant of banking practice at the time the Bank of England was founded that its promoters thought they had secured

a practical monopoly of the business by a provision in the charter which forbade any other company of six members or more to issue promissory notes payable on demand. It was not until 1833 that the first corporation was organized in England to do a deposit and discount business without the currency accompaniment. Up to that time it had not appeared practicable to use cheques instead of bank notes in common transactions. It was the restriction placed upon note issues in England in 1844 and in this country by the National Bank Act which developed the use of the cheque in these countries so far beyond its use elsewhere. In France, Germany, and the other countries of Europe, to the present time, the bank note is still the popular medium of payment.

The National Bank Act, as we shall see, effected a radical change in the character of the bank note. The currency privilege had been so abominably abused under many of the old state bank systems that the true function of a bank currency has been almost totally obscured in this country. The bank note in its ideal capacity belongs in a class with the bank cheque and the bank draft, as a free, unfettered instrument for transferring bank credit. The National Bank Act put it practically in a class with the government note, as a fixed form of currency. In doing that there was a fundamental failure to grasp the true function of the bank note.

The bank note is the natural complement of the cheque in deposit banking. It enables a bank or banking system readily to convert deposits into circulating notes, and thus furnish the community with currency by simply changing the form of its obligations, and in perfect response to the community's needs. Let us take for an illustration the case of a manufacturer, who sells his goods at wholesale and receives practically his entire income in cheques and drafts, for which he receives credit in his bank account. He pays for his supplies usually by drawing cheques on that account. But when it comes to his pay roll that method is not satisfactory because the wage-earner objects to taking the time and trouble during banking hours to get these cheques cashed. The employer accordingly calls upon the banker for money for the pay rolls. He draws a cheque for the full amount and the banker, if permitted by law to do so, would

supply the sum in the bank's own notes. This simply changes the form of the bank's obligation from a deposit promise to a note promise. The wage-earners receive these notes, pay them out to merchants, landlords and others, with *net* result that, within a few days, most of them reappear at the bank as deposits. The bank is now in the position it was before the notes were issued except that a certain amount of credit has been transferred from the manufacturer's account to the accounts of sundry other depositors. In no other conceivable way can this class of payments be so easily and economically handled. They are typical of local payments generally. The notes represent no investment while they are idle in the banker's safe. While they are outstanding adequate reserve of coin is kept against them. The instant they return to the bank they cease to be a charge.

Compare this with the use of gold coin for the pay rolls; the coin makes the same rounds and renders no better service. But, at every stage of its existence, whether in a banker's vault or in circulation, coin represents an investment at its face value. The interest on that investment is a constant charge on the exchanges.

It is evident also that there is a perfect adjustment of the volume of such a bank currency to the calls of the community for cash.

The notes are interchangeable with the deposit credits in any amount without disturbance. The public is able to use personal cheques, bank currency or bank drafts, as best suits the kind of payments to be made. The three forms of bank credit cover every variety of payment in domestic trade. They are all of the same species and together make a complete set of instruments for the transfer of credit, in a system the essential principle of which is that such credits, when brought together in the clearing houses, will balance and settle themselves.

Experience has shown, however, that while a bank's liability is the same whether a customer takes his credit in the form of a deposit subject to cheque or in the bank's own circulating notes, there is more danger of abuse in the latter method of creating credit than in the former. The reason is that the note liability is

somewhat obscured by the use of the notes as a common currency; the notes are scattered far and wide, often by design, and nobody is sufficiently interested in sending them home for redemption to make that an effective check upon overissues. On the other hand, a cheque drawn upon a deposit account, appears immediately at the counter of the bank and, if not completely effective in preventing undue expansion, is an influence to that end.

The world's experience with bank currency, therefore, while demonstrating that it has a function in the exchanges that no other form of credit, not even standard money, can perform, has caused nearly all countries to place restrictions upon it. In most of them the power of issue is now confined to a single institution and exercised under close governmental supervision, this institution being charged with the responsibility of maintaining an adequate gold reserve and supplying all the banks with currency as they need it. The elasticity of the currency is thus in a large degree preserved while effective safeguards are placed about its issue.

The movement in the United States to restrict and control bank currency was a part of a world-wide movement. But in this country the resulting system was shaped by influences that did not exist elsewhere. The purposes held by the founders of the national banking system were realized. It created a market for large amounts of government bonds and eventually made possible a reduction of the interest on the public debt to the lowest rate ever reached in any country upon any class of securities. It gave us a truly national currency, every note good without question or discount in every part of the country. These were very great and perfectly obvious benefits. The superiority of the new currency was especially appreciated by the public, for the defects of the old system were a daily vexation to everybody. Naturally the national system, compared with what had preceded it, became firmly established in the confidence of the country.

Now, of course it is of the first importance that a currency shall be safe. But it is of scarcely less importance that it shall be efficient for the particular service it is expected to perform.

The trouble with the national banking system is that its authors were so intent upon other aims that they lost sight of the essential function of a bank currency, which is to supply an elastic element in the monetary stock.

The fundamental question in dealing with currency is whether or not there is any natural relation between currency and banking. One of the results of the movement to restrict bank issues was the development of a considerable body of opinion in support of the idea that banking should be confined strictly to receiving deposits and making loans; that it should have nothing to do with issuing currency. In England this view became strong enough to change the constitution of the Bank of England, but its advocates there contended only that the banks should do business with gold or notes that represented an equal amount of gold. In this country the idea was greatly encouraged by the issue of United States notes in the form of currency. In the light of this example there developed a party which argued that the issue of money, or anything that had the semblance of money, was an act of sovereignty; that government notes should take the place of all bank notes. One of the most distinguished opponents of a bank note currency responding to an opinion that the government should retire the legal tender notes and "get out of the banking business," epitomized the opposition by retorting that the banks should retire their currency notes and "get out of the government business." Here then is the vital and debatable point in the currency discussion. Is there such a necessary relationship or mutual interdependence between the functions of banking and the functions of a currency system that the two sets of functions must be coördinated in order that either may be successfully performed? That is precisely the contention of those who believe in an elastic bank currency.

There is no real issue over the question of "sovereignty" in this connection. Unquestionably the government must fix the standard of value and determine what shall be legal tender, and nothing else is real money.

It is agreed also that the government should regulate and supervise all forms of private or corporate credit designed for

use as currency, in order to enforce its redemption in gold on demand. Here, however, we approach the limits, not perhaps of the government's authority, but certainly of its ability to perform the function of supplying currency in the volume, at the time, and in the place, required by the changing conditions that affect the business world.

Neither the government officials who come and go at Washington, nor any other authority, can determine in advance how much currency will be required from time to time. Nobody knows how much currency the people of this country will call for next year or even next month. Nobody can tell within hundreds of millions of dollars what the crops of the country will be worth, or what the volume of trade will be next year, or how much of that business will be handled by means of cheques and drafts and how much will require currency; nor can any one tell what part of the $16,000,000,000 of bank deposits in the United States may be called for in cash at any time. All of these demands are uncertain and fluctuating. They are directed, not to the government, not to the offices of the treasury, but to the banks. Not until the government receives deposits and makes loans and enters upon all the functions of banking, will it be in position to measure the demand for currency or to supply it direct. Until then, wherever the authority for issue may be lodged, all supplies must reach the public through the banks.

On the other hand, the banks are expected to supply currency to meet all the fluctuating demands of trade. They are required to pay lawful money or a currency acceptable in its stead for all their deposit liabilities on demand, or confess insolvency. Is there no relationship between this obligation and the function which would enable them to meet it?

The volume of currency cannot be responsive to the needs of trade unless it may be based upon the credit of the traders who use it, backed, of course, by the commodities which are moving. If wanted to move grain it must be based upon the credit of the dealer and the value of the grain, and if wanted for merchants or manufacturers it must be based upon their credit and their goods and materials in stock. Neither a grain dealer nor mer-

chant can give government bonds as security unless he is something more than a grain dealer or merchant; nor can the banker who supplies him with credit give bonds as security unless he is something more than a banker. The banker has no security to offer except what he receives from his customers, and there can be no elasticity in the currency, or certainty that a banking system will meet its obligations, or sure basis for public confidence in time of strain, unless currency can be created upon banking assets.

The requirement that national bank notes shall be secured by government bonds takes them out of the class of responsive currencies. The volume of these notes is determined by conditions utterly foreign to the conditions of trade. There is no connection or relationship between the amount of currency a country needs and the amount of its public debt. It has frequently happened that a period of national prosperity and large revenues has caused a reduction of the public debt at the very time when a larger volume of currency was required. On the other hand, a great war might cause an increase in the debt that would make the currency privilege a menace to our monetary system.

This arbitrary restriction upon bank currency has compelled the banks of this country to do business without any element in the monetary stock that was readily adaptable to the varying demands upon them for currency. The trade of the country fluctuates from time to time, reaching its greatest activity each year during the autumn months. The principal crops are then being moved to market; farmers demand cash, particularly in the case of cotton, which moves rapidly. Large sums of currency, therefore, must be withdrawn from the banks of the central cities. It is a matter of indifference to the farmer whether the currency he needs in the crop moving operation is in the form of a secure bank note or in money that might be the basis of a bank's cash reserve. But it is a matter of the most vital importance to the community served by the bank whether or not it can perform this service by parting with its credit or whether it must invade its cash reserves and consequently shrink the whole credit structure which stands on that stock of reserve money.

The fall of the year is the period of heaviest retail trade. The money withdrawn from the banks passes to the farmers and thence from hand to hand discharging local obligations, eventually reaching the local banks and ultimately finding its way back to the centers after the holidays. Clearly the country needs a great deal more money during the fall months than at any other season, but the supply does not adjust itself to this condition unless the pressure is great enough to force the importation of gold.

There are several reasons why gold does not move readily enough to supply the desired elasticity in our monetary stock. In the first place, our command over gold depends upon numerous conditions that are beyond our control, such as the balance of trade, movement of securities, state of foreign trade and markets, and the attitude of foreign bankers. The season of active trade with us coincides closely with the season of activity in Europe, so that we want more money at the same time they do. Furthermore, if we want it because financial conditions are threatening, the markets of the world are now so closely related that the foreign banker will cling to it for the same reason. When in 1907 we finally broke down all barriers and drew away from Europe heavy supplies of gold, great sacrifices were necessary to accomplish it. Finally, the cost of transporting gold across the ocean and back again in a few weeks, with the loss of interest while in transit, is a heavy charge for a temporary use. The result of these conditions is that this country usually experiences a sharp stringency in the autumn months. Neither money nor credit is available to handle the business of the country to the best advantage. The banks encroach upon their reserves, advance the interest rate to discourage the demand for loans and curtail accommodations as closely as possible. The business public neglects cash discounts, puts creditors off with promises and adjusts itself as best it can to a situation which always involves more or less stress, sacrifice and danger.

It is often said in criticism of the bankers that as these conditions are repeated annually they should provide for them by entering the active season with larger reserves. The individual banker,

however, has but little influence upon the situation. He is controlled by competitive conditions. There can be no unity of purpose or common policy as the system is now constituted. Moreover, there is something obviously wrong in the proposal that large sums of capital shall be kept idle during eight months of the year in order that they may be used as common retail currency during the other four months. If the large transactions of the business world are settled with bank credit it ought to be possible to finance the local trade without passing gold from hand to hand.

But the climax of the system's incapacity and helplessness is seen in the recurring periods of panic when practically the entire banking service of the country confesses its inability to meet the universal test of bank solvency, to wit: the payment of cash on demand.

Although panics never disturb the credit of national bank notes the national banking system has not been able to protect itself, or the public against these disasters. Its $700,000,000 of outstanding notes are secured but its $7,000,000,000 of deposits, practically all payable on demand, are not only unsecured, they are unsupported by any system providing for their ready liquidation. The wisdom of the ostrich which sticks its head in the sand at the approach of danger has its parallel in the fancied security of the national banking system because its notes are protected.

Even this statement does not disclose the entire situation. In addition to the $7,000,000,000 of deposits in national banks there are $9,000,000,000 of deposits in banks operating under state charters. That means, in all, approximately $16,000,000,000 of bank credit dependent upon the responsibility of 23,000 banks (scattered over fifty-one States and Territories) and upon popular confidence in their individual ability to pay cash on demand. Clearly there is no lack of material for panics to work on, although the national bank notes are secured. When in addition it is remembered that the total amount of cash, held by the banks against these deposits, is less than $1,500,000,000, and that the total stock of money in the United States is estimated at less than $3,500,000,000, half of it being gold, there is no mystery about why we have bank panics while other countries do not. In all

other countries the banks have the power to use their ordinary assets as a basis for currency. Even the Bank of England, notwithstanding the Peel Act, in an emergency is allowed to do this. It has repeatedly suspended the bank charter to do it, and the assurance that it will do so, when necessary, is as effective as a statute.

A simple statement of these facts is sufficient to expose the weakness of our banking situation. Public confidence, to be as stable and unquestioning as it is abroad, must have the same basis it has there, to wit: a knowledge that the banks are equipped to meet any demands that may possibly come upon them. It is common knowledge that our banks are not. They have no means of defending themselves or of demonstrating their solvency.

The inherent weakness of the banking situation in this country lies in the fact that it includes so many—23,000 or more—independent and unrelated institutions competing actively with each other and, except for the degree of unlegalized coöperation developed in the Clearing House Associations, without any coherent organization or leadership. It is apparent that the situation is radically different with regard to the practicability of voluntary coöperation and mutual support than it is, for example, in the British Isles, where there are less than 200 banking corporations with over 8,000 branch offices. It is probably true that our numerous banks, owned and managed in the communities where they are located, are less rigid in their rules of business and more responsive to local wants than the branch offices of large outside corporations would be. On the other hand, there is the danger that this responsiveness everywhere to local conditions may be without proper regard for general conditions, which may be all important; that the banking situation as a whole suffers for want of the larger view. It is also true that with so many individual units in the system there cannot possibly be as high an average of experience and ability in the management as will be found, for example, in the twenty-nine banking corporations of Canada.

This system of independent local banks has its advantages and is undoubtedly permanent in the United States. But without

some organized means of coöperation and mutual support these isolated institutions are not only helpless in time of danger, they are a menace to each other. Some of them are certain to be imprudently or dishonestly managed and, under pressure, will succumb.

Every failure at a time when credit is known to be under strain creates more distrust. The pressure upon others, unprepared to bear it, increases. The alarm heightens and spreads until the entire system is prostrate.

But the most disastrous effects and the most striking evidence of the constitutional weakness of the system are seen in the struggles of the individual banks to protect themselves at the expense of each other in every emergency when their strength should be united. The banks lead in a scramble for cash which cannot possibly strengthen the situation as a whole. In fact, it actually hurries on the crisis. At the very time when it is of the highest importance to support credit individual bankers curtail credit by the most drastic methods. And just when it is of the highest importance that the limited supply of money shall circulate with the greatest possible rapidity they seize every dollar within reach and lock it up. In short, the efforts which each bank will naturally make for self-protection in time of panic, and for the most of them the only efforts they can make, are such as must intensify the general alarm.

A banking system should be a source of strength and support to the business community in times of financial strain. It is a recognized principle of banking that in a time of panic, when credit throughout the community is shaken, the banks should show the utmost liberality in extending credit to all who are entitled to have it. There is no limit to which demoralization may not go in the excitement of general alarm, unless solvent houses may obtain their usual accommodations. On the other hand, the steadying influence in every crisis is the buying power of people who have credit in reserve and are influenced by the unusual conditions to come into the market and use it. The banking system is the organization through which these reserve powers are exercised. When that organization breaks down or

refuses to perform its usual function demoralization is complete. Nothing could be more unfortunate when alarm prevails and reaction is under way than for the banks to be forcing the collection of loans in order to make a showing of individual strength or for the purpose of liquidating deposits. There should be some other means of satisfying the anxieties of depositors than by prostrating the business community to do it.

We have seen that bank credit is a factor of constantly increasing importance in the business world. The necessity for a metallic basis for that credit is not in dispute, but the credit transfers through the Clearing Houses of 100 cities in 1910 were one hundred times the total stock of gold in the country. The trade of the world is settled through the banks in reliance upon their solvency; industry and commerce are financed upon bank credit to such an extent that the orderly course of business is dependent upon its stability. Always excepting the integrity of the standard of value itself, there is nothing so vital to the business community as that this vast fabric of credit shall be properly supported.

The importance of protecting bank credit in the form of bank notes has long been recognized, but in the development of banking in the United States since the national system was established, the book liabilities of the banks, from being less than the note liabilities, have become twenty times the note liabilities. It used to be argued that bank notes were a form of credit which should be especially guarded because they were a common currency and the means by which wages were paid. Without qualifying in the slightest the demand for a safe currency it should be added that there is no darker day for the wage-earner than when the banks suspend the payment of deposits and begin a hurried collection of loans. The amount of currency he has in his pocket is not more important to him than regular employment. A persistent demand for the withdrawal of deposits in cash means that the entire system by which industry and commerce is supported is going to pieces.

It is a fundamental condition of banking that a bank shall pay cash on demand. It is this condition that makes bank credit the

highest and most available form of credit. If a single bank fails to meet this test its doors close in ruin and disgrace. Yet the entire banking system of this country may be forced to suspend payment, with inestimable confusion and injury to all business interests, because no system exists for creating an acceptable currency upon bank assets.

It is not to be supposed that the country will go back to unrestricted note issues based upon the individual responsibility of 23,000 or even 7,000 banks; it is impossible for such a division of responsibility to command unwavering confidence. But nobody ever believes that any considerable proportion of these banks are insolvent and it is safe to say that to whatever extent they pledge their credit together it will be unquestioned. The problem of banking reform is to provide a higher form of credit that can be quickly substituted for any particular credit that is threatened. The highest possible form of credit, readily available in any sum required, is a bank note currency based upon the united assets of a national system. When each individual bank in the system can depend upon securing currency of this kind, to the extent of its own approved assets, bank credit in the United States will be safe from any general panic.

SAFEGUARDS AGAINST PANICS

By

Frank A. Vanderlip

The panic of 1907 afforded a convincing demonstration of the inherent weakness of the banking organization in the United States, and awakened for the first time a general interest in proposals for currency reform. The panic of 1893 had occasioned some agitation of the subject and the American Bankers' Association, meeting at Baltimore in 1894, adopted recommendations looking to a more liberal system of bank issues. What was known as the Baltimore plan contemplated issues by all the national banks against their general assets instead of against government bonds or other specified security. In all the later discussion of the subject this class of issues has been known as "asset currency." The silver agitation which came about that time postponed the bank note question and little progress was made for ten years more.

In 1906 the American Bankers' Association appointed a commission to deal with the subject and in 1907 it ratified the action of the commission, which favored issues by all the national banks upon general assets. At that time, however, it was apparent that strong opposition existed among bankers as well as in Congress to a system of unsecured issues by thousands of institutions.

At this stage of the agitation came the panic of 1907. To the average business man it was like a bolt of lightning from a clear sky. The country was prosperous, crops were good, industries were busy and trade was in a healthy and well-balanced condition. That credits were not generally over-extended was proven by the comparatively small number of failures, despite the tremendous shock and strain of the panic. The crisis came at the season of the year when the legitimate demands for money and credit were at the highest. Conditions abroad were unfavorable to the importation of gold and, with no facilities at their command for increas-

ing the supply of currency, the banks of the central reserve cities were unavoidably below their legal reserves of cash and in no position to withstand additional and extraordinary demands.

Up to this time the situation, although strained, was not exceptional for that season of the year, and what followed in 1907 might as well have occurred in 1906 or 1905 or at any time when the banking resources of the country were fully employed. As it happened at this critical juncture in 1907, events transpired which created a "run" upon certain banking institutions in New York City, and the newspaper reports of this started a general movement by banks in the interior to withdraw funds from New York, partly to strengthen their own cash holdings and partly no doubt in anticipation of what actually followed, to wit: the restrictions of cash shipments by the New York banks.

With no means at their command for converting their assets into currency, and facing a demand of immeasurable proportions, the banks of New York City were obliged as a choice of evils to place restrictions upon cash payments; the banks of the other central reserve and reserve cities found it immediately necessary to do the same, and the country banks generally felt compelled to follow their example. It is unnecessary to dwell here upon the enormous cost to the country of the industrial disorganization which followed.

Confronted by this emergency and facing the necessity of satisfying by some means the calls of the public for a circulating medium, the banks acting together through the clearing houses and other similar organizations, proceeded to improvise an emergency currency, acceptable for local use. The public with a most creditable appreciation of the situation, accepted these makeshifts as unavoidable; confidence in the banks was restored by their associated action, and gradually normal conditions were re-established.

The lessons of this experience were not lost. A demonstration had been afforded, not only of the weakness of our banking system while its individual members were isolated and struggling against each other, but of its invincible strength when the banks united their credit and adopted a common policy. It was quickly

recognized that a remedy for banking crises had been found without going back to the distrusted system of unsecured individual bank issues. The banks should be organized into an effective system and the system equipped with the power and the instrumentalities to protect and support its individual members.

The first expression of this new policy in the form of a statute is found in the Aldrich-Vreeland act, a measure avowedly temporary in character, but containing the germ of a new system. Its leading feature is the provision under which the Comptroller of the Currency, with the approval of the Secretary of the Treasury, may issue currency upon the security of certain bonds, but it carries as a subordinate feature a provision by which the banks may form local currency associations and these associations may receive approved assets from their individual members and issue currency upon them. The Aldrich-Vreeland act is a cross-over track from the bond-secured currency system of the national banking act to a system of currency issues based upon commercial assets.

One of the features of the Aldrich-Vreeland act was a provision for a Monetary Commission of eighteen members, of whom Senator Aldrich and Mr. Vreeland, joint authors of the Aldrich-Vreeland act, are influential members. Senator Aldrich as chairman has submitted a tentative draft of a plan which, subject to some suggested modifications, has been formally approved by the executive council of the American Bankers' Association.

The first thing to be said of this plan is that it follows, develops and legalizes the same general procedure to which the banks themselves resorted by common consent in 1907. The clearing-house cheques of 1907, notwithstanding the haste and informality of issue, proved to be as safe a currency as national bank notes, with the advantage of being based upon the natural assets of a commercial bank, but they had no legal status or national character and could not be used in the settlement of balances between localities.

The Commission's plan, adopting the same principle of issue but seeking to unite all of the banks into one system for the exercise of this function, would provide a national currency under

certain definite safeguards which experience has shown should always surround issues of paper money.

It is proposed to form what shall be called the National Reserve Association of America, the capital of which shall be provided entirely by the banking institutions of this country. No other subscriptions will be received and the banks will be allowed to subscribe or acquire stock only in a fixed pro rata of their capital. The authorized capital of the Reserve Association is to be 20 per cent of the capital of all the banks joining it, each bank subscribing that percentage of its own capital. In case a bank increases or diminishes its capital its shares in the Reserve Association will be increased or diminished accordingly. One half of the subscribed capital will be called in at first, and the remainder will probably never be called for, but the subscriptions will stand as a liability of the banks and thus serve to fortify the credit and prestige of the institution in the eyes of the world. Assuming that the banks generally come into it, the National Reserve Association would be much the strongest organization in the world for the performance of banking functions.

It is proposed to allow the Reserve Association to pay dividends upon its outstanding shares up to 5 per cent per annum; after which, and after the accumulation of a given surplus, all profits are to be turned into the treasury of the United States. This disposition of the earnings is consistent with the theory upon which the Association is formed, viz., that it is not an institution for profit, but an association of banks for mutual support and assistance in their service to their local communities, and to enable the banking system as a whole to discharge certain public functions which the individual banks cannot so effectively perform.

The organization of the Reserve Association is modeled after our federal form of government. It begins at the bottom with local bank associations, which must consist of not less than ten banks and not less than $5,000,000 of combined capital and surplus; then the entire country is divided into fifteen districts and the local associations of each district are organized into a district association; and finally the National Reserve Associa-

tion, with its head office in Washington, is founded upon the district associations. The control of the local associations is wholly within themselves; the members elect their own directors and the directors for each district are elected by the banks within that district, and, finally, all of the districts participate in the election of directors for the national association. The plan of choosing directors is ingeniously devised throughout to give the small banks more influence than they would have if their voting power was based upon their holdings of capital stock in the Association. In the local associations, for example, three fifths of the directors are elected by allowing each bank in the association one vote regardless of its size, while the other two fifths are elected by allowing each bank to cast as many votes as it has shares in the Association. A similar plan is followed in electing directors of the district and national associations.

It is interesting in this connection to examine the statistics given in the last report of the Comptroller of the Currency as to the number and capital of national banks:

	NUMBER.	CAPITAL.
All National Banks	7173	$1,002,735,123
Under $100,000 capital	4543	183,640,108
Of $100,000 capital	1247	124,700,000
Of $500,000 and over $100,000 capital . .	1079	267,525,000
Total of $500,000 and under	6869	$ 575,865,108
Over $500,000 capital	304	$ 426,870,015

It is apparent that the great number of small banks would give them a predominating influence in choosing a majority of the directors. A majority of all the capital of national banks is in banks of $500,000 capital and less. If the State banks generally come into the system the strength of the small banks would be further increased. It is also to be noted in considering the relative influence of small and large banks that the latter are grouped in a few central cities and that in any possible arrangement of fifteen districts most of the latter would be controlled by

the banks of moderate capital. It would seem to be clear that the small and medium sized banks would have ample representation in the management of the Reserve Association.

Provision is made that the district and national boards shall each have a number of members chosen from outside of the banking business who shall fairly represent the industrial, commercial and agricultural interests.

The national board, which will be composed of forty-five members, is to contain six *ex-officio* members, to wit: The governor of the Reserve Association, who shall be chairman of the board; two deputy governors, the Secretary of the Treasury, the Secretary of the Department of Commerce and Labor, and the Comptroller of the Currency. An executive committee of nine members is to have the powers of the full board and of these, four, namely, the governor, two deputies, and the Comptroller of the Currency, are appointed by the President of the United States and serve as representatives of the public. As submitted, therefore, the plan contemplates that a very large degree of control will be exercised by the Government, that complete publicity will be given to its affairs and that the institution will be essentially a public rather than private one in its character and responsibilities.

This is the general plan of the organization. Now what is the organization to do? The chief function entrusted to it is the holding of the reserves of the banks, the making of that fund mobile, and thus preventing the disastrous scramble for reserves by all the banks individually whenever there is financial stress Next in importance is the function of issuing the notes of the Association for circulation as currency, based in part upon a gold reserve and in part upon short-time commercial paper. In other words, this organization is to be charged with the responsibility of giving elasticity to our currency supply. It will issue its notes by re-discounting commercial paper for the banks, and under some conditions by making direct loans to the banks upon collateral security. The note-issuing power is exercised by the national association, but through the agency of the fifteen branches. It is desirable that these fifteen branches shall be

directed by one responsible authority, rather than that they shall be in effect fifteen independent institutions. It is fundamental that any system of paper currency shall provide for the maintenance of proper relations between the volume of that currency and a gold reserve, and the experience of the world has shown that this is most certainly accomplished through one central authority and by its control over a uniform discount rate. The prestige and effectiveness of the gold reserve would be lost if it was divided among fifteen institutions; and the burden of meeting all demands would fall directly upon the one reserve at the port through which our financial intercourse with foreign countries is mainly carried on. It follows that we do not want fifteen new kinds of currencies or fifteen separate gold reserves, or fifteen sets of managers with conflicting policies and varying discount rates. There is the same necessity for a supreme authority in control of the national gold reserve as for one authority over all the Nation's forces of defense.

This centralization of authority as to one vital function does not, however, mean a centralization of control over banking facilities. The banks of all sections of the country will have the same freedom of action they have now and will go on making their own policies as they have in the past, and the field will be open to new competitors as heretofore. Furthermore, the banking business will be conducted with a greater sense of security and with more regular and stable policies than the individual banks have been able to maintain in the past. In brief, all of the present banking facilities of the country will remain, enlarged and strengthened, but when the powers of the Reserve Association are called upon they will be administered under one consistent policy, by rules which will make them equally available for all applicants. This is accomplished by regulations strictly defining the kinds of paper which the Reserve Association may receive, and providing that it shall re-discount all the paper of certain preferred classes that is offered and at a uniform rate.

The plan describes four distinct classes of paper which the National Association may receive. Two of these are distinctly preferred in that they may be received without the endorsement

of the local association, but the conditions upon these classes are severe.

First, the Association may re-discount notes and bills of exchange that arise out of commercial transactions; the first condition being that they shall arise out of commercial transactions. The term "commercial transactions" means the class of transactions which are incidental to the regular exchanges of the country; the movement of the crops to market, the current distribution of goods and commodities to supply the consumptive demands of the people. This paper must not represent speculative transactions; it must not represent investment transactions, however conservative. Aside from the question of security, there are two reasons why paper representing fixed investments is barred; first, there is no definite limit to the amount of such offerings and, second, there is no natural or definite maturity for such paper. Its payment probably depends upon a speculative or investment demand instead of a consumptive demand. It is a primary condition of this plan, therefore, that no paper will be re-discounted save such as in the ordinary course of trade will be naturally liquidated at maturity.

If a merchant with an established trade and credit, and with ample capital for the ordinary requirements of his business, borrows at the season of the year when he lays in his heaviest stock and regularly pays out later as he reduces his stock; if a dealer in grain or produce borrows at the season when the crop moves from the producer's hands and pays out as it is distributed for consumption; if a manufacturer borrows at one season to acquire materials or to accumulate stock for the marketing season and pays out regularly at the latter time; these borrowings are of the class which are naturally liquidated within a definite period. They are the most desirable class of loans for a bank to have and the class of transactions from which they arise is the one which the community as a whole is most interested in having protected from interruptions. On the other hand, if money is borrowed to buy land or railway stocks or bonds or to build houses, no matter how good these investments may be, such borrowings are of another class and are expressly excluded from

the privilege of re-discount by the Reserve Association, although they may under exceptional conditions be used as the basis of advances.

But the provision that the paper shall arise from commercial transactions is not the only restriction upon the first class of paper described. This paper must have not more than twenty-eight days to run. The effect of this provision is to make the applicants send in their short maturities first and keep the Reserve Association as liquid as possible. But even this is not all; this paper must have been made at least thirty days before it was offered to the Association for discount. The effect of this is to prevent the manufacture of paper for the occasion; it must be paper taken in the regular course of business. And, of course, all of this paper must be endorsed by the bank which is offering it.

The other class of paper which may be received by the National Association without passing through the local association consists of what are known as acceptances. The only acceptances we have now are drafts drawn by one business house on another and accepted by the latter for payment at a future date; and we do not have many of these because our system of cash discounts induces the best houses to pay cash, borrowing if need be from their bankers. Abroad it is the common practice for banks to accept drafts for their customers, making a small charge, commonly one quarter of one per cent, for the service, after which the paper is sold on the market. Furthermore, the popularity of this kind of paper abroad has resulted in the development of an intermediate class of bankers, known as accepting houses, who make a specialty of lending their credit by this method. The name of an accepting house of known responsibility gives the paper wider currency and reduces the discount rate by enough to cover its charges.

It is generally agreed among experienced bankers that nothing would do so much to mobilize the credits of this country as the introduction of this class of commercial paper. It will do more to assure an ample supply of credit for legitimate and current business at uniform discount rates for all sections, and more to

provide the banks with genuine and high class commercial paper, than any other single provision of our banking laws. It will give a character and fluidity to local credit that it has never had in this country and bring bank credits more generally into conformity with certain accepted rules that are difficult of enforcement upon paper of purely local circulation.

All bankers deem it advisable to have in their portfolios considerable paper originating outside of their depositing patrons, because such paper will be paid without requests for renewal, and the credit situation the country over would be improved by having the percentage of this class of paper increased. The difference in rates of discount between paper of this class and that which does not have access to the general market would be a constant object lesson of the value of compliance with correct banking principles.

The fact that the National Reserve Association will stand ready to take these acceptances and give currency for them will give them a broad market and thus help the different sections of the country to help each other even more than they are helped by the Association direct. The fact deserves to be emphasized that this is not centralization; it is decentralization. The central organization by supporting all of the banks of the system will impart confidence throughout the system and enable the members to deal with each other. Its influence will be against the accumulation of country bank funds in the centers, so long as any part of the country is wanting credit to finance its current business.

Holdings of either class of paper, which may be re-discounted by the Reserve Association direct, will be practically an addition to the cash reserves of a bank, and this will furnish a constant incentive to the banks and to their customers to bring their paper to this standard.

The plan recognizes two additional classes of paper, which may be received by the National Association when endorsed by a local association. First, it may receive paper arising from commercial transactions having more than twenty-eight days, but not more than four months, to run. This paper must be passed by the officers of the local association to which the applying bank belongs and the local association must stand behind it if it defaults; the

members dividing the responsibility on the basis of their capital and surplus.

The local association is authorized to require security, and the borrowing bank is required to pay a commission to the local association which shall be fixed from time to time by the board of directors.

Finally, there is one more class of paper which the National Association may discount, but only under unusual conditions. The three classes heretofore named must all arise from commercial transactions and it is clearly indicated that ordinarily nothing but paper directly related to commercial transactions will be received. But whenever in the opinion of the governor of the National Reserve Association the public interests so require, and such opinion is concurred in by the executive committee, and the Secretary of the Treasury definitely approves, the Association may discount the direct obligation of a bank, provided that obligation is endorsed by the local association and secured by collateral in its hands; but in no case shall the loan exceed two thirds the value of the security so deposited. This class of paper is plainly intended only for emergency use and the terms of its use are such as to preclude offerings under ordinary conditions.

The objections commonly made to bank note systems are that they either permit inflation by having insufficient restrictions, are inelastic because of arbitrary restrictions, or suggest monopoly by fixing control in a single authority. The last objection is met in this proposal by the plan of organization; it is met again, and the other two objections with it, by the regulations covering the classes of paper which the Reserve Association may receive. There can be no undue inflation of credit so long as its use is confined strictly to commercial purposes, nor can there be favoritism if all demands for these purposes are met at a uniform discount rate.

The rate for re-discounts will be the same upon all paper of the same class at all offices of the Association and to all applicants, and all offerings which comply with the conditions will be accepted. If in view of present banking conditions in this country this promise seems impossible of fulfillment the answer is that it

has been realized for years in practically every other important country of the world.

It has been abundantly demonstrated that the demands upon a central re-discounting institution can be controlled by its discount rate. The executive committee of the National Reserve Association will have the financial situation before it. Its members will know the condition of the world's markets; they will know whether the foreign exchanges are in our favor or against us, whether trade is in normal condition or not, whether speculation is prevalent or not, whether the banks are overloaned or not, and the committee can act as a governor upon this situation by means of the discount rate. Its members will occupy an independent position, wholly different from that of bankers who are competing for business. They will be acting for all the banks and for the entire community. They will not be looking for customers; they will not be looking for profits; they will be the guardians of the credit situation; they will take all the paper offered that complies with the conditions, regulating the rate to control the demand.

It is altogether improbable under the organization proposed that the provisions of law governing re-discounts would be deliberately or frequently violated. The intent of the restrictions is clear and with the publicity that will be given to all the operations of the association, the essential regulations could not be ignored without exposure. High officials of the government are named not only as members of the board of directors but of the executive committee, and it is inconceivable that they or the other directors, all of whom will presumably be men of character, will permit false statements of the association to be made. Responsibilities quite as grave as these, and far more difficult of administration, are already entrusted to public officials and others are daily proposed.

These functions, which it is proposed to have the Reserve Association perform, are not in themselves new or experimental. The form of the organization is new, and planned to avoid any radical change in existing banking conditions, and to assure all sections of the country of proper representation in the manage-

ment. The principle of a central discounting organization upon which all other banking institutions may rely, with authority to issue currency, has been developed by a process of evolution and universally accepted. The ability to control the demand by means of the discount rate is fully demonstrated. But in adopting this the plan retains what has been the distinctive and essential feature of banking in this country, to wit: the independent, local bank, owned and managed in the community where it is located. It remains the unit of our banking system and the plan is devoted to providing an organization of these units so that they may more effectually aid and support each other. It aims to accomplish this, moreover, by means which will preserve the individuality of the unit, and offer an incentive to good banking, instead of by placing all banks on a dead level with an obligation to support each other regardless of an individual bank's character, deserts, or qualifications to conduct a banking business. The weakness of the present system is that no matter how carefully a bank may be conducted or how good its assets may be, it may be obliged to suspend payments, because conditions wholly beyond its control create an unusual demand for cash. These conditions may be the result of bad banking by reckless competitors. Good banks may be obliged to come to the relief of such rivals because to allow them to fail might seriously disturb financial conditions. Usually such aid only postpones the evil day. Under the proposed plan it will be possible for every sound bank on the strength of its own assets to obtain at any time whatever cash is required to meet its obligations. When every good bank has the power to protect itself there will be no more panics or fear of panics and every tub will stand on its own bottom.

Vague objections may be raised to centralization of power, but there is no escape from the weakness and incapacity of the present system without creating power somewhere. The plan supplies it by what would seem to be the most unobjectionable method it is possible to devise, the use of an agency which the banks themselves will control, limited in its functions and subject to practically complete supervision by the government.

With this organization or one performing substantially these functions there is little risk in saying that another suspension of cash payments will never be experienced in this country. This in itself is of great importance. It would be of inestimable value to all classes and all interests to have protection against a repetition of the experiences of 1907. But that is not all, or even the chief of benefits. Fourteen years intervened between the panic of 1893 and 1907, but in every year of that time the facilities which the Reserve Association will afford would have been helpful in many parts of the country, particularly in the crop-raising season. They will help every community to use the credit which it is entitled to use and do it under such restrictions and supervision that the banking business of the whole country will be in better condition than it has ever been heretofore. They will enlarge the credit facilities of the local banks for all special and temporary needs, protect the money markets from extreme fluctuations, and make credit conditions more stable and uniform throughout the country.

An effort has been made in the preceding addresses to describe the functions of banking and the services which the banking business is expected to render in the modern industrial and commercial system. There can be no adequate comprehension of the pressing necessity for banking and currency reform unless these functions are understood. Our legislation upon this subject in the past has proceeded largely upon the theory that the principal function of banking is receiving and lending money, whereas the principal function of banking is dealing in credit and the use of money is only incidental thereto. Money in all the ordinary uses of trade is simply a means of transferring credits or settling balances. The great bulk of the business of the world is done without it, except as it serves in bank reserves as the touchstone of value and as a margin of liquid capital that is quickly transferable and available anywhere. The essential and fundamental truth upon which all business relations are based is the fact that the exchanges offset and balance themselves. The bookkeeping function, the service of arranging the offsets, disposes of much the greater part of all the payments that are to be made. This

service is performed by the banks and the fact that so large a proportion of the payments can be settled in this manner and without the use of money, enables the banks to finance the trade of the world so largely upon credit.

Bank credit is based upon the credit of the business public. The banks examine and verify and classify the credit of their customers and with a margin for error are able by the law of averages to create upon this basis a higher and more liquid form of credit which is placed at the service of the business community. And as the credit of one bank is usually better than that of its individual customers so the credit of a group of banks, by the law of averages, is better than that of an individual member of the group, and the credit of a system which included all or the larger part of the banks of a country like the United States would be the highest form of credit in the world.

The vital difference between bank credit and individual credit is in the fact that bank credit is treated as cash. The banks so arrange the maturing obligations of their customers that they can agree to pay all their own obligations on demand, and they make good on the promise so uniformly that their promises are accepted as cash. Their credit, therefore, is buying power. It is paying power. It does everything that money can do. It is more liquid and transferable than money itself. When it is understood that the chief function of banking is dealing in credit and that it is credit, not money, that the banks lend, the old fear that the banks will control the volume of money and conspire to manipulate it for their own advantage becomes absurd. This old fear springs from the idea that banking consists of receiving and lending actual money over the counter, when in fact the banks lend fifty dollars of credit where they lend one of money. The power to issue currency does not add in the slightest degree to the ability of the banking system to manipulate loans. There is not now, and in the nature of things never can be, any physical obstacle to a conspiracy among the banks to manipulate loans, and whether they issue currency or not has nothing to do with the power to make or withhold loans. If there was no money in the country but gold coin and United States notes the banking

business would go on and the money would find its way into the banks, and the banks would make or decline loans just as they do now. The power to issue currency has but one use in a banking system, namely to supply currency to customers when wanted; and there is no possible reason why it should ever refuse currency when they want it. It is simply one form of bank credit and the public frequently find it a convenient form.

The movement pending is designed to put bank credit in the United States on a firmer, more trustworthy basis, than it has ever been before. A banking system, as we have seen, is an agency for organizing all of a country's available resources as a basis of credit. It accomplishes the seeming miracle of enabling capital to be in two places at the same time. In other words, it enables capital in one form or place to stand as a pledge for values or activities elsewhere, and as this agency is perfected and strengthened the efficiency of all our wealth-producing powers are correspondingly increased.

In conclusion let it be repeated as an admonition not to be forgotten for an instant that the vital factor in bank credit is its availability for use as money anywhere at a moment's notice. The banking credit of the United States can never be of the first class while it remains respectable for the banks to suspend payments. And not only must they pay in lawful currency but that currency must be redeemable in gold and the gold reserve must be in sight and ample for the purpose. The authority to issue the currency must be vested in some organization that will have the power to maintain such a reserve. When our banks have a never-failing currency system at their command and the currency system has a never-failing gold reserve behind it the United States will come into the financial leadership which by wealth of resources belongs to it.

COMPOUND INTEREST TABLE

Giving Value of $1 at End of Any Year from 1 to 100. Can Also Be Employed as Table of Powers of 1.005, 1.01, 1.015, 1.02, Etc. Values for r^n in Equation $A = S\frac{r-1}{r^n-1}$

Years	½%	1%	1½%	2%	2½%	3%	3½%	Years
1	1.0050	1.0100	1.0150	1.0200	1.0250	1.0300	1.0350	1
2	1.0100	1.0201	1.0302	1.0404	1.0506	1.0609	1.0712	2
3	1.0151	1.0303	1.0457	1.0612	1.0769	1.0927	1.1087	3
4	1.0202	1.0406	1.0614	1.0824	1.1038	1.1255	1.1475	4
5	1.0253	1.0510	1.0773	1.1041	1.1314	1.1593	1.1877	5
6	1.0304	1.0615	1.0934	1.1262	1.1597	1.1941	1.2293	6
7	1.0355	1.0721	1.1098	1.1487	1.1887	1.2299	1.2723	7
8	1.0407	1.0829	1.1265	1.1717	1.2184	1.2668	1.3168	8
9	1.0459	1.0937	1.1434	1.1951	1.2489	1.3048	1.3629	9
10	1.0511	1.1046	1.1605	1.2190	1.2801	1.3439	1.4106	10
11	1.0564	1.1157	1.1779	1.2434	1.3121	1.3842	1.4600	11
12	1.0617	1.1268	1.1956	1.2682	1.3449	1.4258	1.5111	12
13	1.0670	1.1381	1.2136	1.2936	1.3785	1.4685	1.5640	13
14	1.0723	1.1495	1.2318	1.3195	1.4130	1.5126	1.6187	14
15	1.0777	1.1610	1.2502	1.3459	1.4483	1.5580	1.6753	15
16	1.0831	1.1726	1.2690	1.3728	1.4845	1.6047	1.7340	16
17	1.0885	1.1843	1.2880	1.4002	1.5216	1.6528	1.7947	17
18	1.0939	1.1961	1.3073	1.4282	1.5597	1.7024	1.8575	18
19	1.0994	1.2081	1.3270	1.4568	1.5987	1.7535	1.9225	19
20	1.1049	1.2202	1.3469	1.4859	1.6386	1.8061	1.9898	20
21	1.1104	1.2324	1.3671	1.5157	1.6796	1.8603	2.0594	21
22	1.1160	1.2447	1.3876	1.5460	1.7216	1.9161	2.1315	22
23	1.1216	1.2572	1.4084	1.5769	1.7646	1.9736	2.2061	23
24	1.1272	1.2697	1.4295	1.6084	1.8087	2.0328	2.2833	24
25	1.1328	1.2824	1.4509	1.6406	1.8539	2.0938	2.3632	25
26	1.1385	1.2953	1.4727	1.6734	1.9003	2.1566	2.4460	26
27	1.1442	1.3082	1.4948	1.7069	1.9478	2.2213	2.5316	27
28	1.1499	1.3213	1.5172	1.7410	1.9965	2.2879	2.6202	28
29	1.1556	1.3345	1.5400	1.7758	2.0464	2.3566	2.7119	29
30	1.1614	1.3478	1.5631	1.8114	2.0976	2.4273	2.8068	30
31	1.1672	1.3613	1.5865	1.8476	2.1500	2.5001	2.9050	31
32	1.1730	1.3749	1.6103	1.8845	2.2038	2.5751	3.0067	32
33	1.1789	1.3887	1.6345	1.9222	2.2589	2.6523	3.1119	33
34	1.1848	1.4026	1.6590	1.9607	2.3153	2.7319	3.2209	34
35	1.1907	1.4166	1.6839	1.9999	2.3732	2.8139	3.3336	35
36	1.1967	1.4308	1.7091	2.0399	2.4325	2.8983	3.4503	36
37	1.2027	1.4451	1.7348	2.0807	2.4933	2.9852	3.5710	37
38	1.2087	1.4595	1.7608	2.1223	2.5557	3.0748	3.6960	38
39	1.2147	1.4741	1.7872	2.1647	2.6196	3.1670	3.8254	39
40	1.2208	1.4889	1.8140	2.2080	2.6851	3.2620	3.9593	40
41	1.2269	1.5038	1.8412	2.2522	2.7522	3.3599	4.0978	41
42	1.2330	1.5188	1.8688	2.2972	2.8210	3.4607	4.2413	42
43	1.2392	1.5340	1.8969	2.3432	2.8915	3.5645	4.3897	43
44	1.2454	1.5493	1.9253	2.3901	2.9638	3.6715	4.5433	44
45	1.2516	1.5648	1.9542	2.4379	3.0379	3.7816	4.7024	45
46	1.2579	1.5805	1.9835	2.4866	3.1139	3.8950	4.8669	46
47	1.2642	1.5963	2.0133	2.5363	3.1917	4.0119	5.0373	47
48	1.2705	1.6122	2.0435	2.5871	3.2715	4.1323	5.2136	48
49	1.2768	1.6283	2.0741	2.6388	3.3533	4.2562	5.3961	49
50	1.2832	1.6446	2.1052	2.6916	3.4371	4.3839	5.5849	50

COMPOUND INTEREST TABLE

(Continued)

Years	4%	4½%	5%	5½%	6%	6½%	7%	Years
1	1.0400	1.0450	1.0500	1.0550	1.0600	1.0650	1.0700	1
2	1.0816	1.0920	1.1025	1.1130	1.1236	1.1342	1.1449	2
3	1.1249	1.1412	1.1576	1.1742	1.1910	1.2079	1.2250	3
4	1.1699	1.1925	1.2155	1.2388	1.2625	1.2865	1.3108	4
5	1.2167	1.2462	1.2763	1.3070	1.3382	1.3701	1.4026	5
6	1.2653	1.3023	1.3401	1.3788	1.4185	1.4591	1.5007	6
7	1.3159	1.3609	1.4071	1.4547	1.5036	1.5540	1.6058	7
8	1.3686	1.4221	1.4775	1.5347	1.5938	1.6550	1.7182	8
9	1.4233	1.4861	1.5513	1.6191	1.6895	1.7626	1.8385	9
10	1.4802	1.5530	1.6289	1.7081	1.7908	1.8771	1.9672	10
11	1.5395	1.6229	1.7103	1.8021	1.8983	1.9992	2.1049	11
12	1.6010	1.6959	1.7959	1.9012	2.0122	2.1291	2.2522	12
13	1.6651	1.7722	1.8856	2.0058	2.1329	2.2675	2.4098	13
14	1.7317	1.8519	1.9799	2.1161	2.2609	2.4149	2.5785	14
15	1.8009	1.9353	2.0789	2.2325	2.3966	2.5718	2.7590	15
16	1.8730	2.0224	2.1829	2.3553	2.5404	2.7390	2.9522	16
17	1.9479	2.1134	2.2920	2.4848	2.6928	2.9170	3.1588	17
18	2.0258	2.2085	2.4066	2.6215	2.8543	3.1067	3.3799	18
19	2.1068	2.3079	2.5270	2.7656	3.0256	3.3086	3.6165	19
20	2.1911	2.4117	2.6533	2.9178	3.2071	3.5236	3.8697	20
21	2.2788	2.5202	2.7860	3.0782	3.3996	3.7527	4.1406	21
22	2.3699	2.6337	2.9253	3.2475	3.6035	3.9966	4.4304	22
23	2.4647	2.7522	3.0715	3.4262	3.8197	4.2564	4.7405	23
24	2.5633	2.8760	3.2251	3.6146	4.0489	4.5331	5.0724	24
25	2.6658	3.0054	3.3864	3.8134	4.2919	4.8277	5.4274	25
26	2.7725	3.1407	3.5557	4.0231	4.5494	5.1415	5.8074	26
27	2.8834	3.2820	3.7335	4.2444	4.8223	5.4757	6.2139	27
28	2.9987	3.4297	3.9201	4.4778	5.1117	5.8316	6.6488	28
29	3.1187	3.5840	4.1161	4.7241	5.4184	6.2107	7.1143	29
30	3.2434	3.7453	4.3219	4.9840	5.7435	6.6144	7.6123	30
31	3.3731	3.9139	4.5380	5.2581	6.0881	7.0443	8.1451	31
32	3.5081	4.0900	4.7649	5.5473	6.4534	7.5022	8.7153	32
33	3.6484	4.2740	5.0032	5.8524	6.8406	7.9898	9.3253	33
34	3.7943	4.4664	5.2533	6.1742	7.2510	8.5092	9.9781	34
35	3.9461	4.6673	5.5160	6.5138	7.6861	9.0623	10.6766	35
36	4.1039	4.8774	5.7918	6.8721	8.1473	9.6513	11.4239	36
37	4.2681	5.0969	6.0814	7.2501	8.6361	10.2786	12.2236	37
38	4.4388	5.3262	6.3855	7.6488	9.1543	10.9467	13.0793	38
39	4.6164	5.5659	6.7048	8.0695	9.7035	11.6583	13.9948	39
40	4.8010	5.8164	7.0400	8.5133	10.2857	12.4161	14.9745	40
41	4.9931	6.0781	7.3920	8.9815	10.9029	13.2231	16.0227	41
42	5.1928	6.3516	7.7616	9.4755	11.5570	14.0826	17.1443	42
43	5.4005	6.6374	8.1497	9.9967	12.2505	14.9980	18.3444	43
44	5.6165	6.9361	8.5572	10.5465	12.9855	15.9729	19.6285	44
45	5.8412	7.2482	8.9850	11.1266	13.7646	17.0111	21.0025	45
46	6.0748	7.5744	9.4343	11.7385	14.5905	18.1168	22.4726	46
47	6.3178	7.9153	9.9060	12.3841	15.4659	19.2944	24.0457	47
48	6.5705	8.2715	10.4013	13.0653	16.3939	20.5485	25.7289	48
49	6.8333	8.6437	10.9213	13.7838	17.3775	21.8842	27.5299	49
50	7.1067	9.0326	11.4674	14.5420	18.4202	23.3067	29.4570	50

COMPOUND INTEREST TABLE

(Continued)

Years	½%	1%	1½%	2%	2½%	3%	3½%	Years
50	1.2832	1.6446	2.1052	2.6916	3.4371	4.3839	5.5849	50
51	1.2896	1.6611	2.1368	2.7454	3.5230	4.5154	5.7804	51
52	1.2961	1.6777	2.1689	2.8003	3.6111	4.6509	5.9827	52
53	1.3026	1.6945	2.2014	2.8563	3.7014	4.7904	6.1921	53
54	1.3091	1.7114	2.2344	2.9135	3.7939	4.9341	6.4088	54
55	1.3156	1.7285	2.2679	2.9717	3.8888	5.0821	6.6331	55
56	1.3222	1.7458	2.3020	3.0312	3.9860	5.2346	6.8653	56
57	1.3288	1.7633	2.3365	3.0918	4.0856	5.3917	7.1056	57
58	1.3355	1.7809	2.3715	3.1536	4.1878	5.5534	7.3543	58
59	1.3421	1.7987	2.4071	3.2167	4.2925	5.7200	7.6117	59
60	1.3489	1.8167	2.4432	3.2810	4.3998	5.8916	7.8781	60
61	1.3556	1.8349	2.4799	3.3467	4.5098	6.0684	8.1538	61
62	1.3624	1.8532	2.5171	3.4136	4.6225	6.2504	8.4392	62
63	1.3692	1.8717	2.5548	3.4819	4.7381	6.4379	8.7346	63
64	1.3760	1.8905	2.5931	3.5515	4.8565	6.6311	9.0403	64
65	1.3829	1.9094	2.6320	3.6225	4.9780	6.8300	9.3567	65
66	1.3898	1.9285	2.6715	3.6950	5.1024	7.0349	9.6842	66
67	1.3968	1.9477	2.7116	3.7689	5.2300	7.2459	10.0231	67
68	1.4038	1.9672	2.7523	3.8443	5.3607	7.4633	10.3739	68
69	1.4108	1.9869	2.7936	3.9211	5.4947	7.6872	10.7370	69
70	1.4178	2.0068	2.8355	3.9996	5.6321	7.9178	11.1128	70
71	1.4249	2.0268	2.8780	4.0795	5.7729	8.1554	11.5018	71
72	1.4320	2.0471	2.9212	4.1611	5.9172	8.4000	11.9043	72
73	1.4392	2.0676	2.9650	4.2444	6.0652	8.6520	12.3210	73
74	1.4464	2.0882	3.0094	4.3293	6.2168	8.9116	12.7522	74
75	1.4536	2.1091	3.0546	4.4158	6.3722	9.1789	13.1986	75
76	1.4609	2.1302	3.1004	4.5042	6.5315	9.4543	13.6605	76
77	1.4682	2.1515	3.1469	4.5942	6.6948	9.7379	14.1386	77
78	1.4755	2.1730	3.1941	4.6861	6.8622	10.0301	14.6335	78
79	1.4829	2.1948	3.2420	4.7798	7.0337	10.3310	15.1456	79
80	1.4903	2.2167	3.2907	4.8754	7.2096	10.6409	15.6757	80
81	1.4978	2.2389	3.3400	4.9729	7.3898	10.9601	16.2244	81
82	1.5053	2.2613	3.3901	5.0724	7.5746	11.2889	16.7922	82
83	1.5128	2.2839	3.4410	5.1739	7.7639	11.6276	17.3800	83
84	1.5204	2.3067	3.4926	5.2773	7.9580	11.9764	17.9883	84
85	1.5280	2.3298	3.5450	5.3829	8.1570	12.3357	18.6179	85
86	1.5356	2.3531	3.5982	5.4905	8.3609	12.7058	19.2695	86
87	1.5433	2.3766	3.6521	5.6003	8.5699	13.0870	19.9439	87
88	1.5510	2.4004	3.7069	5.7124	8.7842	13.4796	20.6420	88
89	1.5588	2.4244	3.7625	5.8266	9.0038	13.8839	21.3644	89
90	1.5666	2.4486	3.8189	5.9431	9.2289	14.3005	22.1122	90
91	1.5744	2.4731	3.8762	6.0620	9.4596	14.7295	22.8861	91
92	1.5823	2.4979	3.9344	6.1832	9.6961	15.1714	23.6871	92
93	1.5902	2.5228	3.9934	6.3069	9.9385	15.6265	24.5162	93
94	1.5981	2.5481	4.0533	6.4330	10.1869	16.0953	25.3742	94
95	1.6061	2.5735	4.1141	6.5617	10.4416	16.5782	26.2623	95
96	1.6141	2.5993	4.1758	6.6929	10.7026	17.0755	27.1815	96
97	1.6222	2.6253	4.2384	6.8268	10.9702	17.5878	28.1329	97
98	1.6303	2.6515	4.3020	6.9633	11.2445	18.1154	29.1175	98
99	1.6385	2.6780	4.3665	7.1026	11.5256	18.6589	30.1366	99
100	1.6467	2.7048	4.4320	7.2446	11.8137	19.2186	31.1914	100

COMPOUND INTEREST TABLE

(Continued)

Years	4%	4½%	5%	5½%	6%	6½%	7%	Years
50	7.1067	9.0326	11.4674	14.5420	18.4202	23.3067	29.4570	50
51	7.3910	9.4391	12.0408	15.3418	19.5254	24.8216	31.5190	51
52	7.6866	9.8639	12.6428	16.1856	20.6969	26.4350	33.7253	52
53	7.9941	10.3077	13.2749	17.0758	21.9387	28.1533	36.0861	53
54	8.3138	10.7716	13.9387	18.0149	23.2550	29.9833	38.6122	54
55	8.6464	11.2563	14.6356	19.0058	24.6503	31.9322	41.3150	55
56	8.9922	11.7628	15.3674	20.0511	26.1293	34.0078	44.2071	56
57	9.3519	12.2922	16.1358	21.1539	27.6971	36.2183	47.3015	57
58	9.7260	12.8453	16.9426	22.3174	29.3589	38.5725	50.6127	58
59	10.1150	13.4234	17.7897	23.5448	31.1205	41.0797	54.1555	59
60	10.5196	14.0274	18.6792	24.8398	32.9877	43.7498	57.9464	60
61	10.9404	14.6586	19.6131	26.2060	34.9670	46.5936	62.0027	61
62	11.3780	15.3183	20.5938	27.6473	37.0650	49.6222	66.3429	62
63	11.8332	16.0076	21.6235	29.1679	39.2889	52.8476	70.9869	63
64	12.3065	16.7279	22.7047	30.7721	41.6462	56.2827	75.9559	64
65	12.7987	17.4807	23.8399	32.4646	44.1450	59.9411	81.2729	65
66	13.3107	18.2673	25.0319	34.2501	46.7937	63.8372	86.9620	66
67	13.8431	19.0894	26.2835	36.1339	49.6013	67.9867	93.0493	67
68	14.3968	19.9484	27.5977	38.1213	52.5774	72.4058	99.5627	68
69	14.9727	20.8461	28.9775	40.2179	55.7320	77.1122	106.5321	69
70	15.5716	21.7841	30.4264	42.4299	59.0759	82.1245	113.9894	70
71	16.1945	22.7644	31.9477	44.7636	62.6205	87.4626	121.9686	71
72	16.8423	23.7888	33.5451	47.2256	66.3777	93.1476	130.5065	72
73	17.5160	24.8593	35.2224	49.8230	70.3604	99.2022	139.6419	73
74	18.2166	25.9780	36.9835	52.5632	74.5820	105.6504	149.4168	74
75	18.9453	27.1470	38.8327	55.4542	79.0569	112.5176	159.8760	75
76	19.7031	28.3686	40.7743	58.5042	83.8003	119.8313	171.0673	76
77	20.4912	29.6452	42.8130	61.7219	88.8284	127.6203	183.0421	77
78	21.3108	30.9792	44.9537	65.1166	94.1581	135.9156	195.8550	78
79	22.1633	32.3733	47.2014	68.6980	99.8075	144.7501	209.5648	79
80	23.0498	33.8301	49.5614	72.4764	105.7960	154.1589	224.2344	80
81	23.9718	35.3525	52.0395	76.4626	112.1438	164.1792	239.9308	81
82	24.9307	36.9433	54.6415	80.6681	118.8724	174.8509	256.7260	82
83	25.9279	38.6058	57.3736	85.1048	126.0047	186.2162	274.6968	83
84	26.9650	40.3430	60.2422	89.7856	133.5650	198.3202	293.9255	84
85	28.0436	42.1585	63.2544	94.7238	141.5789	211.2111	314.5003	85
86	29.1653	44.0556	66.4171	99.9336	150.0736	224.9398	336.5154	86
87	30.3320	46.0381	69.7379	105.4299	159.0781	239.5609	360.0714	87
88	31.5452	48.1098	73.2248	111.2286	168.6227	255.1323	385.2764	88
89	32.8071	50.2747	76.8861	117.3462	178.7401	271.7159	412.2458	89
90	34.1193	52.5371	80.7304	123.8002	189.4645	289.3775	441.1030	90
91	35.4841	54.9013	84.7669	130.6092	200.8324	308.1870	471.9802	91
92	36.9035	57.3718	89.0052	137.7927	212.8823	328.2191	505.0188	92
93	38.3796	59.9536	93.4555	145.3713	225.6553	349.5534	540.3701	93
94	39.9148	62.6515	98.1283	153.3667	239.1946	372.2744	578.1960	94
95	41.5114	65.4708	103.0347	161.8019	253.5463	396.4722	618.6697	95
96	43.1718	68.4170	108.1864	170.7010	268.7590	422.2429	661.9766	96
97	44.8987	71.4957	113.5957	180.0896	284.8846	449.6887	708.3150	97
98	46.6947	74.7130	119.2755	189.9945	301.9776	478.9184	757.8970	98
99	48.5625	78.0751	125.2393	200.4442	320.0963	510.0481	810.9498	99
100	50.5049	81.5885	131.5013	211.4686	339.3021	543.2013	867.7163	100

ANNUITY TABLE

Giving Yearly Payments Required to Redeem $100 (per cent.) at End of any Year from 1 to 100. Per cent. Values for A in Equation $A = S \frac{r - 1}{r^n - 1}$

Years	2½%	3%	3½%	4%	4½%	5%	6%	Years
1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	1
2	49.38	49.26	49.14	49.02	48.90	48.78	48.54	2
3	32.51	32.36	32.19	32.03	31.88	31.72	31.41	3
4	24.08	23.90	23.73	23.55	23.37	23.20	22.86	4
5	19.02	18.84	18.65	18.46	18.28	18.10	17.74	5
6	15.65	15.46	15.27	15.08	14.89	14.70	14.34	6
7	13.25	13.05	12.85	12.66	12.47	12.28	11.91	7
8	11.45	11.25	11.05	10.85	10.66	10.47	10.10	8
9	10.05	9.84	9.64	9.45	9.26	9.07	8.70	9
10	8.93	8.72	8.52	8.33	8.14	7.95	7.59	10
11	8.01	7.81	7.61	7.42	7.23	7.04	6.68	11
12	7.25	7.05	6.85	6.66	6.47	6.28	5.93	12
13	6.60	6.40	6.21	6.01	5.83	5.65	5.30	13
14	6.05	5.85	5.66	5.47	5.28	5.10	4.76	14
15	5.58	5.38	5.18	4.99	4.81	4.63	4.30	15
16	5.16	4.96	4.77	4.58	4.40	4.23	3.90	16
17	4.79	4.60	4.40	4.22	4.04	3.87	3.54	17
18	4.47	4.27	4.08	3.90	3.72	3.55	3.24	18
19	4.18	3.98	3.79	3.61	3.44	3.27	2.96	19
20	3.91	3.72	3.54	3.36	3.19	3.02	2.72	20
21	3.68	3.49	3.30	3.13	2.96	2.80	2.50	21
22	3.46	3.27	3.09	2.92	2.75	2.60	2.30	22
23	3.27	3.08	2.90	2.73	2.57	2.41	2.13	23
24	3.09	2.90	2.73	2.56	2.40	2.25	1.97	24
25	2.93	2.74	2.57	2.40	2.24	2.10	1.82	25
26	2.78	2.59	2.42	2.26	2.10	1.96	1.69	26
27	2.64	2.46	2.29	2.12	1.97	1.83	1.57	27
28	2.51	2.33	2.16	2.00	1.85	1.71	1.46	28
29	2.39	2.21	2.04	1.89	1.74	1.60	1.36	29
30	2.28	2.10	1.94	1.78	1.64	1.51	1.26	30
31	2.17	2.00	1.84	1.69	1.54	1.41	1.18	31
32	2.08	1.90	1.74	1.60	1.46	1.33	1.10	32
33	1.99	1.82	1.66	1.51	1.37	1.25	1.03	33
34	1.90	1.73	1.58	1.43	1.30	1.18	0.96	34
35	1.82	1.65	1.50	1.36	1.23	1.11	.90	35
36	1.75	1.58	1.43	1.29	1.16	1.04	.84	36
37	1.67	1.51	1.36	1.22	1.10	0.98	.79	37
38	1.61	1.45	1.30	1.16	1.04	.93	.74	38
39	1.54	1.38	1.24	1.11	0.99	.88	.69	39
40	1.48	1.33	1.18	1.05	.93	.83	.65	40
41	1.43	1.27	1.13	1.00	.89	.78	.61	41
42	1.37	1.22	1.08	0.95	.84	.74	.57	42
43	1.32	1.17	1.03	.91	.80	.70	.53	43
44	1.27	1.12	0.99	.87	.76	.66	.50	44
45	1.23	1.08	.95	.83	.72	.63	.47	45
46	1.18	1.04	.91	.79	.68	.59	.44	46
47	1.14	1.00	.87	.75	.65	.56	.41	47
48	1.10	0.96	.83	.72	.62	.53	.39	48
49	1.06	.92	.80	.69	.59	.50	.37	49
50	1.03	.89	.76	.66	.56	.48	.34	50

ANNUITY TABLE
(Continued)

Years	2½%	3%	3½%	4%	4½%	5%	6%	Years
50	1.03	.89	.76	.66	.56	.48	.34	50
51	0.99	.85	.73	.63	.53	.45	.32	51
52	.96	.82	.70	.60	.51	.43	.30	52
53	.93	.79	.67	.57	.48	.41	.29	53
54	.89	.76	.65	.55	.46	.39	.27	54
55	.87	.73	.62	.52	.44	.37	.25	55
56	.84	.71	.60	.50	.42	.35	.24	56
57	.81	.68	.57	.48	.40	.33	.22	57
58	.78	.66	.55	.46	.38	.31	.21	58
59	.76	.64	.53	.44	.36	.30	.20	59
60	.74	.61	.51	.42	.35	.28	.19	60
61	.71	.59	.49	.40	.33	.27	.18	61
62	.69	.57	.47	.39	.31	.26	.17	62
63	.67	.55	.45	.37	.30	.24	.16	63
64	.65	.53	.44	.35	.29	.23	.15	64
65	.63	.51	.42	.34	.27	.22	.14	65
66	.61	.50	.40	.32	.26	.21	.13	66
67	.59	.48	.39	.31	.25	.20	.12	67
68	.57	.46	.37	.30	.24	.19	.12	68
69	.56	.45	.36	.29	.23	.18	.11	69
70	.54	.43	.35	.27	.22	.17	.10	70
71	.52	.42	.33	.26	.21	.16	.10	71
72	.51	.41	.32	.25	.20	.15	.09	72
73	.49	.39	.31	.24	.19	.15	.09	73
74	.48	.38	.30	.23	.18	.14	.08	74
75	.47	.37	.29	.22	.17	.13	.08	75
76	.45	.35	.28	.21	.16	.13	.07	76
77	.44	.34	.27	.21	.16	.12	.07	77
78	.43	.33	.26	.20	.15	.11	.06	78
79	.41	.32	.25	.19	.14	.11	.06	79
80	.40	.31	.24	.18	.14	.10	.06	80
81	.39	.30	.23	.17	.13	.10	.05	81
82	.38	.29	.22	.17	.13	.09	.05	82
83	.37	.28	.21	.16	.12	.09	.05	83
84	.36	.27	.21	.15	.11	.08	.05	84
85	.35	.26	.20	.15	.11	.08	.04	85
86	.34	.26	.19	.14	.10	.08	.04	86
87	.33	.25	.18	.14	.10	.07	.04	87
88	.32	.24	.18	.13	.10	.07	.04	88
89	.31	.23	.17	.13	.09	.07	.03	89
90	.30	.23	.17	.12	.09	.06	.03	90
91	.30	.22	.16	.12	.08	.06	.03	91
92	.29	.21	.15	.11	.08	.06	.03	92
93	.28	.21	.15	.11	.08	.05	.03	93
94	.27	.20	.14	.10	.07	.05	.03	94
95	.26	.19	.14	.10	.07	.05	.02	95
96	.26	.19	.13	.09	.07	.05	.02	96
97	.25	.18	.13	.09	.06	.04	.02	97
98	.24	.18	.12	.09	.06	.04	.02	98
99	.24	.17	.12	.08	.06	.04	.02	99
100	.23	.16	.12	.08	.06	.04	.02	100

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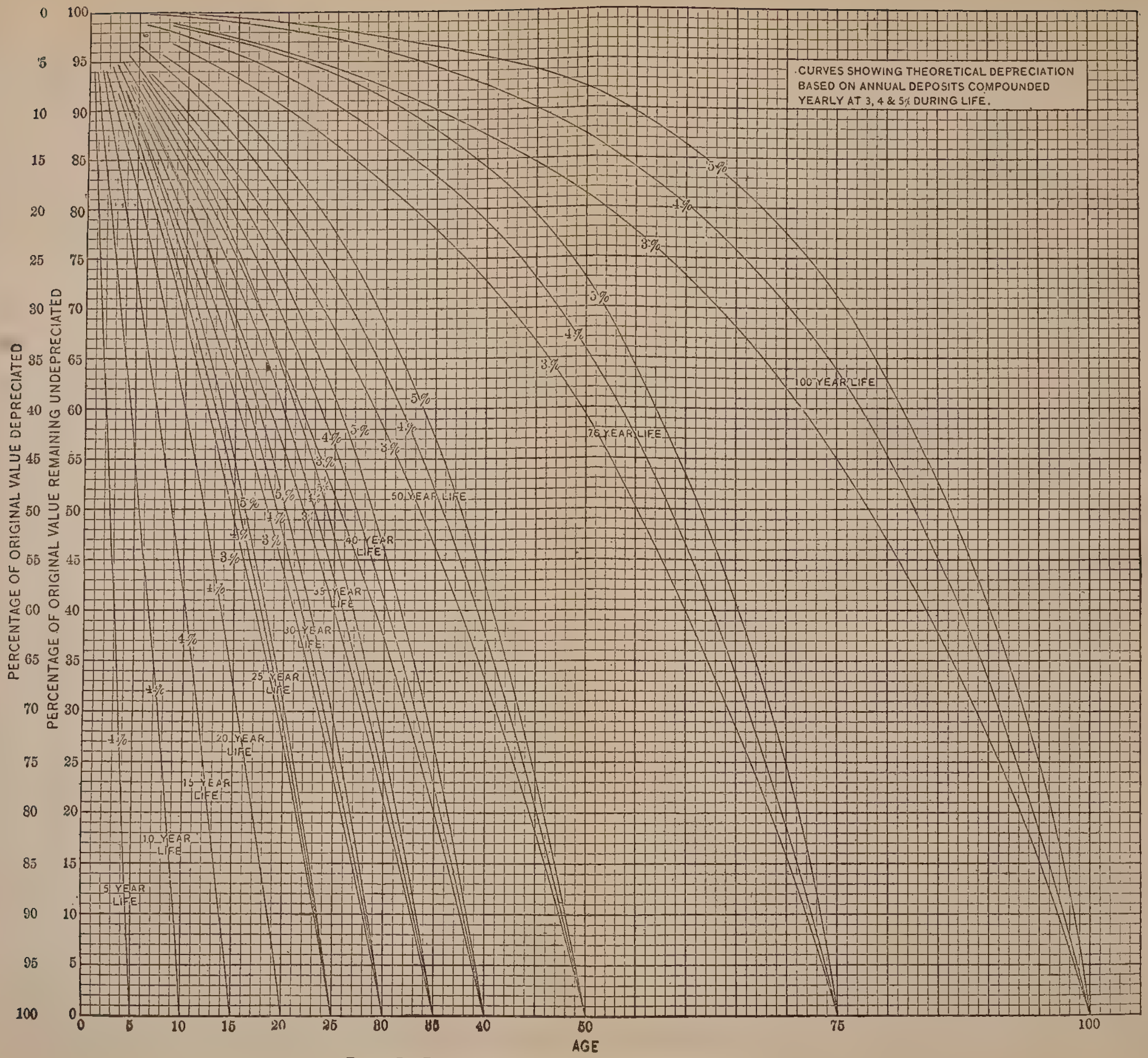

PLATE I.—Depreciation as related to electrical properties

[Floy]

Deacidified using the Bookkeeper proc
Neutralizing agent: Magnesium Oxide
Treatment Date: Nov. 2003

PreservationTechnologi
A WORLD LEADER IN PAPER PRESERVA
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Cranberry Township, PA 16066
(724) 779-2111

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